Bulletin of the Atomic Scientists

Vol. V February, 1949 No. 2

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Published monthly by the Atomic Scientists of Chicago, 1126 E. 59th Street, Chicago, 37. Phone: MIdway 3-3056. Manuscripts should be sent in triplicate to H. H. Goldsmith at the above address.

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Subscription price—$3.50 a year. Single copy—35 cents. Four weeks' notice is required for change of address; both old and new addresses must be given.

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MILITARY AND POLITICAL CONSEQUENCES OF ATOMIC ENERGY: SOME VIEWS ON BLACKETT'S BOOK

On its appearance in England, Professor Blackett's book[1] provoked considerable controversy both in scientific and in political circles. With its appearance in the United States, under the name of **Fear, War, and the Bomb**[2]*, it is certain to provoke even more commentary here.*

Professor P. M. S. Blackett is a distinguished British physicist whose work during the war was concerned with the mathematical evaluation of the results of military operations. This experience makes up the first, technical part of his book, and the conclusions are used in the subsequent, political part, to support a point of view, particularly in the field of international control of atomic energy, which differs considerably both from the beliefs developed by American and British atomic scientists in 1944-45, and from the official positions of their respective countries.

In the present issue, the **Bulletin** *presents reactions to Blackett's book by Professor E. Shils, Professor P. Morrison, Senator McMahon, and excerpts from a review in Moscow's* **Pravda**. *Naturally, these reviewers—as well as those in the general press—deal mainly with the political aspects of Blackett's conclusions. Whatever the judgment on Professor Blackett's political conclusions, his book raises a number of questions of military and economic prognosis in the field of atomic energy which call for a more detailed and technical discussion than was possible in these immediate reactions. The* **Bulletin** *intends to present articles dealing with these questions in its subsequent issues.*

Unfortunately, the information available on some of them is very restricted. Professor Blackett raises the possibility of bacterial warfare as an important argument in his discussion of international control of atomic energy. His critics refer to radioactive poisoning as an aspect of atomic warfare neglected by him. In both cases, the information on which the argumentation is based is quite inadequate. It is to be hoped that the American government will find it possible to release enough information in these and other relevant fields, such as atomic power production, to make intelligent public discussion possible.

Blackett's Apologia for the Soviet Position

Edward A. Shils

Mr. Shils is Reader in Sociology at the London School of Economics and Associate Professor in the Committee on Social Thought at the University of Chicago. He is a member of the **Bulletin's** *Editorial Board.*

PROFESSOR P. M. BLACKETT'S *Military and Political Consequences of Atomic Energy* is especially meritorious in presenting for the first time an ingeniously argued and more or less well-documented apologia for the Soviet behavior in the UNAEC.

The aggressive debating tactics of Mr. Vishinsky, even when making the simultaneity "concession," served notice that the new sessions of the UNAEC and of the six sponsoring powers will probably not be free of that evasive dogmatism, abusive reiterativeness, and exasperating refusal to explain whatever rational grounds exist for a position, which characterize the Soviet conduct of diplomatic "negotiations." The previous suspension of the UNAEC was certainly motivated in part by the majority's irritation with the uncooperativeness of the Soviet spokesmen. Reasonable discussion and understanding had become even more difficult than the very real differences in the positions of the majority and the minority necessitated.

AT THE same time, the intellectual poverty of Soviet atomic bomb policy has caused a deterioration in the quality of the argument of the majority spokesmen. There has been a tendency to shift from factual explanations to self-righteous re-enunciations of general themes. Where no specific counter-arguments or proposals are made by the Russians, it is only too easy to slip into the repetition of generalities. In doing so, our arguments have become vaguer and less convincing and we have ceased to think on the fundamental issues. However justified the majority position is on the nature of the necessary control, there are a number of important issues such as the veto on sanctions, the "stages" question, etc., on which concessions can and should be made.

The atmosphere created by the mode of debate of the Soviet delegates and their evident lack of earnestness has made it difficult even for quite reasonable men to recognize the rightfulness of some of these concessions from our side. In order to re-examine our own position critically and make sure that our arguments are really meeting the questions which arise in the minds of honest and troubled men, it is important that a rational justification of the Soviet position should be produced at this time so that it may serve as a spur to the coherent and rational restatement of our own standpoint.

Blackett writes from the Stalinist standpoint. All his main conclusions and premises are those which are found in the pamphlets of ordinary Communist propagandists: e.g.,

[1] P. M. S. Blackett, *Military and Political Consequences of Atomic Energy* (London: Turnstile Press, 1948). Pp. 216. 12*s*, 6*d*.

[2] New York: Whittlesey House, McGraw-Hill Book Co., 1949. Pp. 244, $3.50.

the "conspirational theory of society" according to which every decision in bourgeois society is made by a small group of men, always behind the scenes, who act with complete rationality, complete consistency, perfect foresight, and total malevolence; the apocalyptic war of good against evil: the yearning of Americans for a preventive war against the Soviet Union; the good and virtuous ground for every Soviet action, however offensive it might appear at first sight; the devious selfishness behind every American action, however generous it might appear to the naked eye, etc.

Thus in Professor Blackett's opinion, Soviet expansiveness is only an attempt to prevent the Americans from getting atomic bomb delivery bases too close to Soviet frontiers, while American expansiveness is a fear-and-guilt-impelled striving for world hegemony. The atomic bombs were dropped on Japan solely and exclusively to check the Soviets. Americans support the Marshall Plan so that "the national economies of the Western Powers will be markedly strengthened so as to make much more feasible than at present their active participation in a third world war." The Baruch proposals were simply a propaganda device to put the Soviet Union into an embarrassing position, etc., etc.

Professor Blackett is a master of artful and intelligent distortion, and his extraordinary analytical powers placed in the service of his strong political prejudices and aided by his schematic and overly rationalistic conception of human motives, especially the motives of politicians, produces a picture which frequently bears little resemblance to reality. But between his unrealistic premises and his ordinary Stalinist conclusions, there are some very impressive pieces of analysis, and his keen mind discerns significant issues and presents serious arguments where less skilful Stalinist writers are merely blindly and unreasoningly aggressive.

PROFESSOR BLACKETT'S analysis—in its substantial part—rests on a remarkably well-argued "debunking" of the atomic bomb as a decisive instrument of a push-button war. Some of his triumphs are gained over rather easy opponents, e.g., when he proves that a war cannot be won by atomic bombs alone, or when he argues against the likelihood of an atomic war in the near future.

His most significant and powerful arguments, based on the data of the U.S. Strategic Bombing Survey, are not, however, conclusive. He wishes to show that Anglo-American strategic bombing did not reduce the total output of the German economy over several years. But when he attempts to draw a lesson from this as to the probable inconsequentiality of an atomic bomb war for a large industrial economy, he descends into a fundamental fallacy: he cites the rise of German production curves over several years under a certain number of tons of bombs as evidence that the delivery of an equivalent explosive power of atomic bombs would have only the same largely inconsequential effects on the economy subjected to it.

He does not recognize that where only one small area of an economy is damaged at a time, the rate of the recovery of the economy from that injury depends on the recuperative power available from the other undamaged parts of the economy, e.g., shadow plants, fire-fighting and health-protecting equipment, replacements, etc., and that where the total damages are inflicted, not successively over several years in small doses, but almost simultaneously over several weeks, the resources for recuperation will be very greatly diminished.

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By refuting the extreme claims of those who think that very small numbers of bombs could be decisive in any war, that there is no defense whatsoever against atomic bombs, and that atomic bombs can be effective regardless of the problem of their delivery, and by arguing that even where large stockpiles of bombs exist, the delivery problems are very great, he concludes that the dangers attendant upon any future war from the existence of atomic bombs are not as great as many people think.

THIS being the case, Professor Blackett believes that small amounts of diversion of nuclear fuel would not be injurious to security and that, accordingly, the majority proposals of the United Nations Atomic Energy Commission seek a degree of security which is unattainable and unnecessary. Moreover, this quest for absolute security has resulted in the proposal of a control scheme which could not possibly be accepted by the Soviet Union so long as that country was concerned with its own security.

It is true that Professor Blackett asserts that some control of the atomic bomb is desirable — particularly its elimination from national, especially American, armaments—and he also asserts that this could be achieved only in the context of a general disarmament scheme in which the Soviet Union might give up some of its land forces in return for American renunciation of the atomic bomb. But, in general, the bomb is no particular danger, except in so far as people become unnecessarily and unjustifiably frightened by it.

He thinks, therefore, that the Soviet Union has been entirely justified in rejecting the proposals of the UNAEC and that the justice of its action has been misinterpreted by a public opinion which has been dazzled by the specious generosity of the American proposal and by the fear-impelled overestimate of the significance of the bomb. (According to Professor Blackett, American scientists overestimate the destructive power of the bomb because they feel guilty for having created it and for having allowed it to be misused.) The justification for the Soviet rejection lies primarily in the restrictive effects on Soviet economic development of the quota system of distribution of nuclear fuel in accordance with the principle of strategic balance.

Professor Blackett offers no evidence

whatsoever to show that the strategic balance or quota system would damage the power production of the Soviet economy either in the short run or in the long run. Indeed, all he shows is that the Soviet economy is much poorer with respect to the production of power than the American economy, and that some American writers, who are definitely in the minority and without influence on governmental policy (characteristically, he does not mention this) favor a moratorium on the production of atomic energy for industrial purposes in order to avoid some of the more intricate questions of international control.

The UNAEC never examined the quota question in sufficient detail to allow Professor Blackett to draw any support from their deliberations for his apodictic statement, and he presents no evidence of his own. It does not appear implausible that in any scheme of strategic balance which attempted to improve the Soviet strategic position *vis-a-vis* the United States with respect to the amount of operations involving "dangerous" quantities of nuclear fuel going on in its territories, the Soviet Union would gain more in power production than if it were left to its own independent efforts.

It might have been consistent with Professor Blackett's views to argue that the strategic balance suggestion in the Lilienthal Report and its derivatives was not sincerely proposed, or he might have contended that the Soviet Union by its own unaided efforts in science and engineering would advance more rapidly to close the gap between the United States and itself with respect to the production of atomic power than under some specified allotment of resources in a strategic balance scheme. He asserts neither and yet rests at least half of his main argument in defense of the Soviet rejection of the majority scheme on what is merely an unsupported assertion.

SECOND, he justifies the Soviet rejection of the UNAEC proposal by reference to the strategic disadvantage to the Soviet Union of a system of surveillance which would disclose to potential enemies the location of the major industrial centers of the country which are now secret. Yet, in his praise of the conciliatory attitude of the Soviet Union and its alleged willingness to agree to a system of inspection, Professor Blackett does not find it relevant to comment on the danger to Soviet secrecy which even a periodic inspection system would entail, nor does he perceive any contradiction between his praise of the realistic pursuit of self-interest on the part of the Soviet Union and his praise of its willingness to make concessions which would be on his own argument damaging to its security.

The same contradiction is to be found in the treatment of the quota question: on the one hand, he claims that the Soviet Union could not accept the UNAEC proposals as far as the quota feature is concerned because they would cripple its economic development; and, on the other hand, while arguing that the Soviet Union is always entirely realistic in seeking its own interest, he finds Gromyko's expression of a wish to see in the quota question a possible "bridge" between the majority and minority persuasive evidence of the Soviet's genuine desire for a compromise and a genuinely effective control scheme.

If the Soviet Union is as realistic in its attitude to the atomic bomb as Professor Blackett claims, then the concessions, if sincerely offered, represent an inconsistency in Soviet policy and contradict Professor Blackett's specific claim as well as his general conception of politics. On the other hand, if the "concessions" are not sincerely offered and are simply part of an effort to "play for time," as he himself seems to believe, then his praise of the Soviet longing for agreement is simply Stalinist propaganda.

In all instances Professor Blackett seeks to vindicate the Soviet Union. In some cases, where it suits his argument, he attributes to the Russians an omniscience about American opinion which they surely do not have and a real grasp of the long-run economic and strategic implications of the atomic bomb. Again, when it suits the immediate needs of his argument, which is always directed ultimately to the complete support of Soviet policy and action, he asserts that the Soviet Union has had to "play for time" in the UNAEC because the situation was so novel and the issues were not clear.

He also argues that the "stages" element in the majority proposal would have been too injurious to the security interests of the Soviet Union since it would have required a disclosure of Soviet industrial locations (at present, Western ignorance of these is a very great Soviet advantage) while leaving America in control of the atomic bombs for some time to come.

Here he has an important thesis which, as usual, he uses for polemical purposes rather than as a point of departure for constructive suggestions as to how a telescoped "stages" scheme which minimized the losses to both of the main principals could be worked out. His responsibility in this matter is especially great given his official position, his technical knowledge, and his long preoccupation with atomic bomb problems. Instead, he embellishes his argument with an interpretation of Mr. Baruch's speech of June 14, 1946, in which he deduces that the Americans never intended to give up control of the atomic bomb until bacterial weapons too were subjected to control—a construction comparable in ingenuity and common sense to that found among students of the cabala.

Here, as elsewhere, Professor Blackett writes as an extremely quick-witted and resourceful propagandist, seeking more to distribute blame and praise, more to justify and condemn, than to discover possible solutions. Yet his emphasis on the importance of the "stages" problem is very worthy of our attention, even though he offers absolutely nothing of value to its solution.

PROFESSOR BLACKETT makes clear in many places that he regards the entire atomic energy discussion as it has taken place in the UNAEC as a propaganda battle. He attributes that interpretation to the Americans and he seems to think it right that the Russians should interpret it in the same way. He sees no particularly urgent need for international control of any sort over the atomic bombs even though he approves of the Soviet proposals for limited periodic inspection. He therefore regards as one of the main tasks of the Soviet Union the avoidance of the loss of that propaganda battle, while at the same time, avoiding the acceptance of any of the significant majority proposals.

The recent concession of simultaneity made by Mr. Vishinsky must, if we follow Professor Blackett and especially if we study the proceedings of the Political Committee and the Subcommittee A-111, also be re-

garded as an effort by the Soviet Union to "play for time" and to evade the onus of having frustrated a constructive solution to a major problem.

We may be sure, given the relative matter-of-factness and specificity of Professor Blackett's argument, which states a defense for the Soviet Union position so much better than any Soviet delegate has ever stated it, that it will play a great role in the speeches of the Soviet and satellite delegates. Indeed it has already done so. It is therefore necessary that this gift to Soviet propaganda be studied and understood. The unfounded allegations of base motives, the subtle distortions, and the unreality of Professor Blackett's mode of argument should not blind us to the fact that he has written a book with a high degree of superficial plausibility (and fundamental speciousness). It cannot be refuted or dismissed by self-righteous clichés. It must be met by rational argument derived from the detached re-examination of our own position and by the careful point-by-point consideration of the Soviet proposals which Professor Blackett defends with energetic dialectic and without any substantial evidence. It is only in this way that the combination of impressive but not always relevant data, ingenious and arbitrary construction, and maliciously doctrinaire innuendo which make up Professor Blackett's book can be prevented from doing damage to political understanding.

Blackett's Analysis of the Issues

Philip Morrison

Professor Morrison is a nuclear physicist who took part in the design and fabrication of the bomb at Los Alamos Laboratory. He is now a member of the Physics Department at Cornell University.

IT IS three years since the writing of the first extensive political work of the atomic scientists: *One World or None*. Now the same publishers put out the American edition of a book by another scientist, the distinguished, well-informed, and earnest P. M. S. Blackett of Great Britain. As a contributor to the first book, I feel no proprietary pangs in urging all those who bought or borrowed it—and there were many—to get hold of the Blackett book.

It is written at a sadder time, and perhaps a wiser one. It is written by a man whose experience is both that of a physicist and that of a military man, and who is no American, but an Englishman, willing to take a somewhat more critical position on the issues of the day than almost any American scientist has publicly done. It is a book which does Professor Blackett credit for its thoughtfulness and scope, even though as he himself points out it is by no means "the whole truth." Read it, if you wish to have an opinion on the issues of atomic energy.

My piece in *One World or None* was the description of the effect of a single atomic bomb on New York City. It is a frightening article, as I have many times tested by direct observation. Yet it is a major thesis of the Blackett book—and I believe a correct thesis—that even a thousand bombs will not of themselves decide the issue of a major war. We said there is no defense, and we meant it. It is still true But we spoke in a different language from the language of Blackett. We did not speak in terms of strategy, in terms of over-all economies, in terms of production and territorial conquest. We spoke of the impact of the bomb on the homes and the hopes of men and women.

I wrote of the lingering death of the radiation casualties, of the horrible flash burns, of the human wretchedness and misery that every atomic bomb will leave near its ground zero. Against this misery there is indeed no real defense. Neither our oceans nor our radar nor our fighters can keep us intact through another major war. But—and I quote Blackett (p. 159): the very effective campaign, largely initiated by the atomic scientists themselves, to make the world aware of the terrible dangers of atomic bombs, played an important part in bringing pressure to bear on the American Government to propose measures to control atomic weapons and to take them out of the hands of the military. The very success of this campaign was in the end one of the major causes of the failure of the plans for control. For the American public became so frightened that nothing but the prospect of 100 per cent safety became acceptable. The only possible way in which the American people can obtain complete safety from atomic bombs is by effective American control of all other nations. . . . . So the widespread publicity to the real 'Horrors of Hiroshima' unwittingly gave impetus to a drive to attain as great a security as America had enjoyed in the past. Clearly this could only be attained by measures which were themselves likely to provoke a third world war and so to increase the likelihood of more Hiroshimas. In fact, as in ordinary life, the only real safety lies in taking reasonable risks. But to the overcharged imagination and the uneasy conscience of the American public no risks appear reasonable.

And at another place (p. 189):

Moreover, it is likely that only through a third world war could such changes occur as would make a really water-tight system possible by leading to the effective hegemony of one or other group of Powers. Given the present deadlock, the problem before the world is whether there is any control system which, though falling short of the demands for complete security, does offer something better than nothing.

This is the chief political conclusion of Blackett.

Let us try to follow Professor Blackett's line of argument in some detail. He is one of the leading figures in operational analysis, and the book is written as one might expect in a quasi-statistical style, very rich in content for any scientist, and suitably qualified and made meaningful by generally frank and almost always concrete statements of policy, method, and judgment. The first quarter of the book is devoted to an analysis of strategic bombing and the atomic bomb on the basis of World War II experience. The fascinating and valuable data of the United States Strategic Bombing Survey are drawn upon heavily; I was moved to look up the documents of the Survey themselves and found them even more valuable and interesting than Professor Blackett's use led me to suspect. They are by no means well enough known and cry for publication in more accessible form.

THE history of strategic bombing is given at some length, and we see clearly how Britain and America, though neither Germany nor Russia, have made of it a basic military doctrine. The great campaign of mass destruction by air attack which was the work of the B-29's against Japan he calls the "first fairly successful one in history." For this success he adduces the conditions which were patent to anyone on the scene, including especially the complete supremacy in the air, both over the target where the bombs dropped and over the highly concentrated, valuable, and vulner-

able air fields of the Marianas. And, as he says, "the attacking power expected no help from, nor had any sympathy with, the attacked population."

He moves on to an account of the physical effects of the atomic bomb, and to a prognosis of delivery possibilities in the next five years, during the American bomb monopoly, and in, say, the next ten. He holds that a decade is a reasonable limit for his cautious predictions.

On the subject of delivery, he agrees with the almost unanimously accepted opinion that the subsonic bomber and the short-range guided missile of the next five years will have a weary path to any fairly distant target. Beyond that time, the jet bombers of the late fifties will have improved interceptor missiles to evade, and he concludes that long-range bombing even then will be necessarily in "great force" and at considerable expense in money, bases, men, and planes.

He discusses future developments and mentions biological warfare and the dispersal of fission product poisons. In the absence of any very informative published data, he leaves these topics rather vague, though he ventures an opinion on the probable circumstances in which America might use weapons "much more devastating than the atomic bomb" if they were available.

HIS estimate of the strategic impact of the atomic bomb at present is perhaps the most debatable of all his technical points. His conclusion is (p 61): "that a long-range atomic bombing offensive against a large continental power is not likely to be itself decisive within the next five years." More quantitatively (p. 88): "it is certain that the number of atomic bombs required to produce decisive results in war between America and Russia would run into thousands." He derives this conclusion from the accepted estimate of tonnage equivalence for an atomic bomb (about 3000 T of ordinary bombs per *improved* atomic bomb) and the fact that Germany received 1.3 million tons of bombs, at rates up to fifty atomic-bomb equivalents per month, without decisive result.

He gives very brief attention to two objections to this calculation and omits one important factor. The uncertain effect of saturation — the very high rate of atomic destruction—he minimizes, since he argues that a few thousand bomber sorties will occupy a time at least of the order of a month, and even that the highest rate of bombing may well not be the most advantageous, because it uses up the bombs and bombers quickly and thus relieves the enemy of the need for long-time defense measures. Against the psychological horrors of the bomb, he says with great reasonableness that the survivor of Hamburg or Tokyo would have had as poignant a story for Hersey as those of Hiroshima. The Germans stood bombing on a scale fifty times larger than the RAF enthusiasts thought enough to bring about their collapse. But he does neglect the persisting effects of radioactivity from ordinary atomic bombs, made so evident at Bikini Test Baker, even in the little material already published.

FOR these reasons, I thought it worth while to go beyond Blackett in an effort to satisfy myself as well as one can in this admittedly complex, difficult, and speculative subject.

The U. S. Strategic Bombing Survey made a study of a sample of ten German cities, of all sizes and of a wide range of bomb damage, in which they were able to measure the damage ascribable to area raids—those directed against "a city as a target" by large bomber forces. This seems the best analogue to the atomic bomb attack. Including both the indirect loss in industrial production due to necessary replacement and repair as well as that from actual lost working-time and damaged facilities, the overall figure can be translated into the rough equivalent of a loss of 1 per cent of a year's national industrial production per fifty square urban miles destroyed. The USSBS figures are given in terms of damage to housing units; this was given its rough area equivalent using the figure of ten thousand population per urban square mile.

If one takes into account the fact that the two great powers today are much larger than Germany, it seems reasonable to correct this figure for their increased urban area, which in the Soviet Union, for example, is about 1.8 times that of Germany. On this basis we would estimate that it would take from ten to fifteen atomic bombs on urban areas to produce a loss of 1 per cent of annual national industrial production. The effect of saturation is not included in this figure, nor the very large atomic casualty rate. We ought to include the casualty rate, probably not at the high ratio of Hiroshima of some twenty times as many casualties per equivalent ton of ordinary bombs but, say, at about five times. This would mean roughly loss of 1 per cent of a year's production and some 200,000 casualties per dozen atomic bombs on target.

In the Nazi attack against the western Republics of the USSR, the production of the whole country dropped to half in six months' time, and slowly recovered. One may roughly and very conservatively measure the economic loss as about one to two years' national production, plus some ten million casualties, plus a large long-term loss in actual territory controlled. If we add to the known A-bomb effects an estimate—a rough guess—that a dozen bombs may make some twenty urban square miles unusable for some years from fission product activity (plutonium contamination when very dilute would seem to be a weapon against the people of the post-war period, when delayed tumors ought to appear in large number, and not a weapon of much direct military consequence), it appears that to equal the terrible impact of the Nazi attack would mean from eight hundred to twelve hundred or more bombs on urban targets, giving a comparable or a little smaller reduction in national production, a somewhat higher rate of economic loss, a larger casualty list, and an effective interdiction of productive areas about comparable. The Germans did not win the war against the Soviets, in spite of the fact that the German Army added a huge direct force, which had to be opposed, to the economic damage it inflicted. So much for my own footnote to Blackett.

The delivery of under a thousand bombs on target certainly means the launching of many more than a thousand under present conditions. With a probable loss rate of something like a third in each bomber sortie, with the need for a good many escort ships for defense and for such purposes as radar counter-measures, this implies many thousands of bomber sorties and a large number of bombers. Bases go with them, and supply, and defense. And what force replaces the Wehrmacht?

WE THUS support Blackett's two principal military conclusions: that atomic bombs by themselves can only be decisive — decisive beyond doubt—when numbered in the thousands, and that a major war will not be a three-week aerial expedition, but

a world-wide conflict with all weapons, lasting many years. I believe that I have taken into account, at least roughly, the effects of saturation and radioactivity without essentially modifying Blackett's conclusion. The atomic attack in force would not be unimportant—on the contrary, it would be as grim as the most terrible blow that any people has suffered anywhere, anytime—but it does not seem that it could of itself settle the issue in total war between the great states of today. I abstract from humane considerations entirely!

It is clear that those in our country who talk of a cheap preventative war, and place their hopes on fifty-five bomber groups and the A-bomb, are exposing our country to a military gamble in the most reckless way. Hitler was no more of an adventurist than they. This conclusion is not new; the Federation of American Scientists has long said it; General Omar Bradley, our Chief of Staff, has made the point eloquently. Blackett gives it emphasis and uses it in support of his political conclusions. He draws the important and nearly self-evident corollary "that a small number of atomic bombs, say a few dozen, are likely to be of little military significance if used for mass destruction in a war between two major powers."

In spite of the clarity of this theorem, I can personally testify to the difficulty of getting it faced squarely in the 1946 discussions which led to the official formulation of US policy on the question of diversion of material from peacetime plants. In the same vein, the somewhat romantic idea of a war waged by espionage, or even anonymously, with a few planted bombs, says Blackett, "has done a great deal to be-devil the issue of what type of control system is required."

THE last of his military chapters includes an account of the present strategy of the A-bomb. He urges that "the USSR is much less likely to initiate an attack upon European and American cities than the USA is likely to use them against Russian cities." In support of this, he points out that the technical possibilities, in terms of bombs, bombers, and especially bases, all lie with America. Moreover, the Russian military theory holds that war must be fought out "by the co-ordinated use of all arms," and Blackett considers that the necessary supporting invasion of America by Russia is militarily impossible. And Russian politico-military thinking involves not only winning over a section of the American population, but especially avoiding the solidification of a world alliance against her.

The USA, on the other hand, has not only the technical means, but also has accepted the use of mass-destruction tactics as a normal operation, largely to find some means of offense not involving large American casualties. But Blackett believes this theory unsound and concludes with General Bradley "that a war between America and Russia would be of world-wide extent and would be a war of all arms, and certainly of very long duration."

SO FAR half the book, the military consequences of the bomb. Now comes a chapter, again informing and quantitative, on the possibilities of atomic power for peace. He makes the familiar point that the United States has a surplus of power sources and may minimize the importance of a new one. He quotes the Australian delegate, Dr. Evatt, revealingly as very much concerned with the possibilities for remote Australia. On the other hand, Professor Blackett recognizes, for example, that "new technical discoveries stir the imagination of Americans more than most other people." But his conclusion is that the prevailing American point of view on atomic energy is conditioned to fear the bombs the more because we have never been attacked in modern war, and to esteem atomic power the less because we are still rich in energy sources.

From this standpoint, Blackett develops a rather clear and critical estimate of the history of atomic energy control proposals, first in the US, and then in the UN, principally as a case-study in the postwar antagonism of US and USSR. He reviews the early pre-bomb Franck paper, the Lilienthal Plan, and the final Baruch Proposals. He estimates the Lilienthal Plan as "appealing to the deeply felt internationalist longings which are always to the fore after a destructive war," and as "a constructive effort to solve the problem of atomic energy on an international basis." He rightly grounds much of its impact in the American domestic political battles of the time. He believes it might have made a starting-point for a solution if modified (1) to minimize the effect of a possibly biased international control on national economic affairs, (2) to introduce a scheme of stages of operation "which would give adequate and reciprocal advantages to each of the major nations from the start and at each stage," and (3) to ensure that "the Charter was not modified so as to make possible a legalized third world war." He concludes that the Baruch Proposals contained no such modifications, but only made sure that the Atomic Authority could have prevented Soviet atomic development if the US and the Western powers so desired, that the early stages proposed were in every case favorable to USA and detrimental to Soviet immediate security, and that the UN Charter would be modified by the limitation of the veto in this field. He describes the Soviet reaction quoting some extremely interesting, though rather old, articles from the Soviet press. Essentially, he finds that the Soviets began with an initial rejection of the proposals in a delaying form of discussion, and that they eventually progressed toward the present considerable area of technical agreement. The Soviets have, in fact, moved considerably in the direction of meeting the rational demand for "an adequate inspection by an international inspectorate of all national atomic plants." He emphasizes the importance to the Russians of the early stages of control, pointing out that "the threat to Russia from American bombs exists *now*, while the threat to America from Russian bombs is some years *in the future*." He finds the present central dispute to be over ownership, and he says that the majority was departing from the realms of political reality by its insistence on the ownership and management function.

He finds the third clash in the veto. He sums up with this (p. 194):

So, in essentials, the deadlock remained to the end much as it was in the beginning. For sound objective reasons, Russia and America put forward proposals appropriate to their own interests. Owing to the great difference between the strategic situations of the two Powers and between the level of their atomic energy developments, these proposals were completely antagonistic, and each completely unacceptable to the other.

Disheartening, but true. It is one important defect of this close-knit book that he gives very sketchy consideration to the possible "bridge" of the quota proposal.

In the last full chapter, he discusses the present state of affairs. He holds

that the bomb, and indeed, any foreseeable new weapon, will not much change the strategic realities. "It is overwhelmingly to Russia's advantage to avoid a war," he concludes from an account of the rather obvious economic-strategic state of affairs, and, on the other hand, "America is for a number of reasons unlikely to precipitate one." These reasons include mainly the military-political ones that we can undertake offensive action only in three main ways, all evidently undesirable: (1) by participating in a chaotic quasi-civil war between the Western Union and Russia; (2) by fighting in a mass European land war ourselves; and (3) by the atomic attack analyzed above, which is dangerously likely to prove indecisive.

BLACKETT takes the role, not of a builder, but of an analyst. He ends with only four pages on "A Way Out?" with a question mark. But he has on the first leaf stated that "the world has a plethora of recipes in the field of atomic energy, but too little diagnosis and too little understanding." His way out is to broaden the discussions on disarmament to include both conventional and atomic weapons, and to proceed slowly on a basis of *quid-pro-quo*, reducing Russia's land arms as we reduce our bomb strength. Then, gradually, we might proceed to limitations of all weapons against the civilian population, accompanied by inspection of all major arms as the penultimate step. Finally, we may hope to move to a Lilienthal-like scheme "when some form of world state is in being, or when relations between separate states are entirely friendly." He ends with a sentence in which he says that it is impossible to predict the form of a future world government system, or its origin, but that "it is easy to predict that it will not begin with world government in one weapon and one commodity."

This is a long review of a short but meaty book. There are three comments I must still make. First, Blackett's method is one of rational analysis. He freely admits, but he does not discuss at length, the complexities and irrationalities of history. His is a theory of history which I myself share. In the language of the physicist, it is the most probable way to understanding. But the fluctuations are not small, though in the long run they may be unimportant. The RAF bomber offensive of 1941-43 was unsoundly conceived, but it burned many homes. The arbitrary actions of generals anywhere, especially with A-bombs at their command, can perhaps start a chain of events which brings disaster. It seems to me, therefore, that it is precisely the lesson of Blackett's book that we American atomic scientists must work hard to act as dampers on fluctuations, as refrigerants to the cold war. If cool heads, and not cold war, were America's motto, we could prevent the irrational outbreaks which might, in a world of atomic arms, spell real human disaster. We can slowly bridge the gap between the rather tough and military-looking David Lilienthal of today and the Lilienthal of the famous plan. But he is the same man, and a good one. It is that gap in behavior which symbolizes the cold war and the need for reason, patience, and slow steps to the great goal. The most probable state is peace; but we will never reach it if we have too many bombs, too many secrets, and too little criticism.

SECOND, Blackett has a fascinating, though admittedly conjectural digression on the dropping of the first bomb. It must be read, not summarized. He argues that the decision to use the bomb was motivated mainly by the desire to end the war before the Soviet Union came in. It is a different matter whether, even if this explanation is correct, the Hiroshima explosion can be described as "not so much the last military act of the second World War, as the first act of the cold diplomatic war with Russia." While the matter is complex, he is cogent. I can testify personally that a date near August tenth was a mysterious final date which we, who had the daily technical job of readying the bomb, had to meet at whatever cost in risk or money or good development policy. That is hard to explain except by Blackett's thesis, for the tenth was about the date on which the Russians had agreed to enter the war. The question of motive is not, of course, finally answered by any such observations.

THIRD, Blackett's book has been intemperately and even officially attacked in spite of its moderate and reasoned air and its by no means extreme conclusions. The *ad hominem* attack on Professor Blackett seems to reflect a really strong wish to discredit anyone who characterizes the Baruch Plan as *"Realpolitik"* in the face of the unanimous newspaper self-righteousness about American atomic policy. That our policy of making plenty of bombs, of using the atomic threat diplomatically, of proffering control on our own inflexible terms, of talking of "Oriental maneuver" is in fact tough power politics is hard to doubt. But it would be presumptuous for me to "defend" Professor Blackett; he is fully capable of that, as his book eloquently testifies. All I have done is sympathetically outline his arguments. No review, damning or laudatory, can be a substitute for having the full arguments of this important book known, discussed, and weighed by everyone who would be well informed. Read the book, and form your own opinion.

Comment on Blackett's Book

Brien McMahon

Senator Brien McMahon sponsored the legislation under which our domestic organization of atomic energy operates. He has recently been appointed Chairman of the Joint Congressional Committee on Atomic Energy.

DR. BLACKETT, the well-known British physicist, has written a book "debunking" atomic weapons. Yet Dr. Blackett's arguments, far from disparaging the atom, impress me as strengthening our fears.

He estimates, for example, that some 400 "improved" bombs "would have been required to do the same damage to Germany as was actually done by the Allied bombing offensive, assuming the same average accuracy of attack and the same distribution in time."

This estimate is a narrow and cautious one. It ignores the likelihood that atomic bombs would cause many more human losses than an "equivalent" tonnage of ordinary bombs. It does not allow for lingering radiation which might delay the repair of devastated zones. The estimate assumes, too, that each of the 400 bombs would burst in the air. However, if some were detonated underwater in harbors,

the victim nation might not only lose its port facilities but also suffer great havoc from radioactive spray which drifted over populous industrial areas.

But taking 400 bombs as the least quantity needed to duplicate the ruin visited upon Germany, how can we conclude that atomic energy is an exaggerated menace? Must we not conclude, rather, that 400 bombs is a terrifyingly small number? Must we not conclude that hostile planes, aided by surprise and attacking at night, could deliver 400 bombs in one raid and that America might suffer as much damage between sunset and sunrise as Germany suffered in six whole years of aerial warfare? Any American who has seen the horror of present-day Germany — as I have — may perhaps be pardoned for committing what Dr. Blackett regards as a cardinal sin, namely, placing atomic weapons in a class by themselves.

CURIOUSLY enough, Dr. Blackett uses his terrifyingly low figure of 400 bombs as a basis for arguing that the atomic bomb alone cannot play a decisive role in any world war fought during the next five or ten years. He contends that the "equivalent" of 400 atomic bombs was not even decisive in defeating Germany and that, therefore, it would certainly fail to subdue either America or Russia. The fact that Germany absorbed aerial punishment slowly at first and in heavy doses only after a long, gradual build-up does not impress Dr. Blackett. He indicates that concentration of the punishment in a very brief time—as is possible with atomic weapons—would make little difference, and that the bombed nation could still continue to fight.

This is really like arguing that if you put out both a man's eyes and cut off an arm and a leg, he may nevertheless survive. Accepting the argument as valid, is it comforting to learn that we will keep struggling after we lose two-thirds of our big cities?

Actually the argument can be challenged on many grounds. For example, Dr. Blackett quotes liberally from Liddell Hart's book entitled *The Revolution in Warfare*, but he does not quote the following passage from that book: . . . decisive results come sooner from sudden shocks than from long-drawn pressure. Shocks throw the opponent off his balance. Pressure allows him time to adjust himself to it. That military lesson is closely linked with the general experience of history that human beings have an almost infinite power of accommodation to degradation of living conditions, so long as the process is gradual.

Liddell Hart, himself a highly conservative military thinker, seems to imply that Dr. Blackett is wrong and that brief, severe atomic attacks could achieve a decision against Russia or America.

Both countries possess an Achilles' heel which Dr. Blackett neglects. Russia's weak point may consist of the flimsy railroad network which binds her far-flung empire. Our own weak point is the 50,000,000 Americans who live in crowded cities of 30,000 or more people. If 400 of Dr. Blackett's "improved" atomic bombs landed suddenly on these cities, and if average casualties merely equalled those inflicted upon Nagasaki, we would suffer 16,000,000 deaths and 16,000,000 injuries—a total of 32,000,000 or 23 per cent of our entire population. The near simultaneous detonation of 400 bombs might also create such intense clouds of radioactivity as to occasion many additional American losses. Germany surrendered when only about 15 per cent of her people became casualties; and Japan surrendered when only about 8 per cent of her people had been struck.

WITHOUT speculating about pure radiological warfare or the possibility of a new superbomb, I am inclined to fear that atomic weapons numbered in hundreds could be delivered rapidly and could force the surrender of America or Russia. But there is no need to quibble over numbers. Dr. Blackett admits that "thousands" of bombs might conquer a continental power; and he further refers to the time when Russia will possess this many bombs.

In other words, Dr. Blackett is like the man who leaps from the top of a skyscraper and who shouts, while passing the fifth-story window, "Everything's fine so far." Dr. Blackett does not expect Russia to amass thousands of bombs for some years, and, therefore, he informs us that our fears are exaggerated and that "Everything's fine so far" because, in his extremely cautious appraisal, any war during the next decade could only ravage America to the extent Germany was ravaged.

It is easy to point out other remarkable aspects of Dr. Blackett's book. He regards the "Horrors of Hiroshima" as "real" but deplores the publicity given this reality. He concludes that atomic weapons are not so frightening after all—but frightening enough to justify Russia in enslaving the countries of Eastern Europe and using them as a "cushion" against atomic attack. America's attempt to secure allies is portrayed as sinister imperialism, but Russia's complete domination of 100,000,000 Europeans is at least pardonable if not actually praiseworthy.

THE fact that Germany, with all her technical and industrial genius, rarely shot down 10 per cent of an Allied bomber formation does not discourage Dr. Blackett from discoursing at length upon raids in which 90 per cent of the attackers would invariably be destroyed. He pictures 2,000 miles as an extreme range for aircraft developed during the next five years; but existing planes, with a bomb-load and full combat equipment, have already proved the feasibility of ranges over 4,000 miles. He stresses that an aggressor's air bases would be vulnerable to counter-attack; but he fails to mention the aggressor might exploit surprise to destroy his victim's bases and thus avert retaliation. He speaks of atomic raids confined to military points and factory areas—just as though an aggressor could destroy Floyd Bennett Field in New York City or the Pittsburgh steel mills without also destroying tens of thousands of civilians.

Dr. Blackett's criticism of the United Nations plan for control of atomic energy assumes that the atomic bomb is "just another weapon"—an assumption which his own arguments refute. Logically, then, the apologies he advances for Russian rejection of the United Nations plan crumble to the ground.

Dr. Blackett argues that the Kremlin fears atomic controls because these would involve a factory quota for each nation and thus—allegedly—limit Russia's use of the atom for industrial power. But here Dr. Blackett has clearly outwitted himself. Russia's own diplomats express approval of factory quotas—about the only feature of an effective control plan which they do endorse. Therefore Dr. Blackett has put an excuse in Stalin's mouth which Stalin's personal spokesmen contradict. Of course America never has and never will advocate placement of a ceiling on the use of atomic energy for peaceful purposes.

Dr. Blackett suggests that the Kremlin does not trust us—that lack of confidence helps explain its attitude. Here again Dr. Blackett has outwitted himself. Since the men of the Kremlin know that we alone possess

atomic weapons and since they persist in an aggressive policy, they must repose the utmost faith in America's passion for peace. Otherwise, the Kremlin would surely appease us with all its might and main, until Russia had amassed her own atomic weapons. Furthermore, the whole point of our control proposal is to guarantee security for all men and all nations, no matter how intensely they may mistrust one another. Also, to say that the Kremlin balks because it lacks confidence is to become involved in a vicious circle. How else could men create real confidence except through the establishment of atomic peace?

AN EFFECTIVE control plan must take effect by gradual stages. According to the Lilienthal plan the first stage would consist of a world-wide survey for uranium deposits. Dr. Blackett reasons that America would peek behind the Iron Curtain, would learn the location of Russian factories and bases as a result of the first stage, but would not surrender atomic weapons until afterward. Thus, if plans for control broke down at the end of the first stage, Dr. Blackett claims that Russia would have lost important secrets, whereas we would have lost nothing.

But this argument puts the Kremlin in the position of a man who murders his father and mother and then pleads for mercy as an orphan. By raising an Iron Curtain between the Russian people and Western peoples, the Kremlin has in my judgment committed an act of aggression against the peace of the world. Yet Dr. Blackett pleads that we must sympathize with Moscow because the first stage of a control plan would mitigate the effects of that crime.

Today Russians can travel anywhere they please in America. They know the exact location of our big factories, our military bases, our vital points. We do not even know the location of whole cities situated behind the Russian Urals. Perhaps Dr. Blackett would have us drop an Iron Curtain ourselves, relocate all our own cities and factories, and generally remake the map of the United States. Then, in the first stage of a control plan, the Kremlin would discover as much new intelligence about us as we discovered about the Soviet Union.

Dr. Blackett also emphasizes that Russia might be outvoted by other countries sitting on an atomic control commission. But the language of any treaty establishing UN control over the atom would protect all of Russia's legitimate rights. If she could not always have her way on issues left to the discretion of a control commission, the same would be true of America and every other state. Does Dr. Blackett advise us to let the Kremlin conquer all of Europe and all of Asia—so that it would then dictate to a majority of the world's nations and thus be certain of having its way on every issue, large and small?

In all of Dr. Blackett's long book only one footnote hints at what may be the real reason why Moscow opposes the United Nations plan. Is the Kremlin afraid that Russians who became UN inspectors would visit America and observe the American standard of living? Is the Kremlin fearful that these Russians would taste the heady wine of liberty—and that they would compare their own unhappy plight with conditions in the West?

Is the Kremlin perhaps afraid that Western inspectors in Russia would glimpse Soviet concentration camps? Does the Kremlin fear that Europeans would observe its secret police in action, its iron-fisted control of labor unions, and the luxuries accorded members of the communist élite as compared with the poverty-stricken lot of ordinary Russians?

Certainly the Iron Curtain nourishes and protects the Kremlin in many vital ways. Russia can appropriate our technical knowledge and use it to forge weapons, without offering anything in exchange. She can keep her eye on us, though we cannot keep our eye on her. She can see, but we are blind.

Even more important, the Iron Curtain means that Moscow can flood the Western world with propaganda; Moscow can use our own democratic instruments of publicity to undermine democracy; and yet Moscow can prevent Western ideas and Western opinion from reaching Russia. When Vishinsky or Molotov addresses the United Nations Assembly, his words are printed in newspapers throughout the globe. When an American ventures to reply, his speech is printed only in the West—never in the East.

I gravely fear that the Iron Curtain has enabled the Kremlin to win brilliant victories in the propaganda war—as evidenced by Dr. Blackett's book. Since the Kremlin exports revolutionary symbols but never imports them, since the Kremlin can use the United Nations as a sounding board to magnify its voice, but can muffle the sound of anyone else's voice, Russia speaks in a roar, and we respond with a whisper.

Are these the real reasons why the Soviet opposes atomic peace? Does Moscow believe that lifting the Iron Curtain would result in disclosures shocking to the civilized world? Such pertinent questions are not even asked, much less discussed, in Dr. Blackett's book.

We know that anything less than effective atomic control would be worse than nothing. Under a slipshod, faulty plan neither America nor Russia could afford to assume that the other was not making atomic weapons in secret. Under such a plan both sides would consider it more dangerous to "play fair" than to "cheat." Or, if we "played fair," the Kremlin might "cheat" and thereby amass enough hidden weapons to threaten the world. Therefore, given a plan containing loopholes, the armaments race would continue. The control proposals we originally made; the proposals which the United Nations has studied, revised, and improved; the proposals which the great majority of mankind now supports—these proposals are the minimum necessary to safeguard one and all against foul play.

DR. BLACKETT tries to argue that our insistence upon effective control is really a foolish demand for absolute security. He might as well argue that insistence upon policemen to regulate motor traffic is the same as demanding the total abolishment of automobile accidents. Absolute security against atomic attack vanished forever on July 16, 1945, when the first bomb was tested at Alamogordo, New Mexico. Even if men established a full-blown world government, they might later fight a world civil war in which atomic weapons would be used. Even if Russia or America established an hegemony over the whole earth, a later revolt might bring atomic weapons into play. If the United Nations control plan were adopted, any nation at any time could seize the atomic plants located in its territory, exclude international inspectors, and commence producing weapons. The remaining countries, forewarned, would, of course, race to produce atomic weapons for defense. We ask only for the least restraints, the least controls which would make it safer for all peace-loving nations to destroy atomic armaments than to continue manufacturing them.

I will not dwell on the point that Dr. Blackett writes a book to attack

the United Nations plan and then proposes nothing concrete in its place. The UN plan is based on an appreciation of the technical facts and the facts of nuclear physics. The spectacle of a noted nuclear physicist defying those laws and advancing vague suggestions which ignore the technical facts speaks for itself.

Nor will I dwell on Dr. Blackett's attempt to blacken our motives in using the two atomic bombs against Japan. Here he commits a logical fallacy so obvious that it could hardly have escaped his own notice; even if some "hindsight" commentators are right in saying that Japan would have quickly surrendered without the use of the two bombs and prior to a land invasion, President Truman lacked this knowledge at the time of his decision. Dr. Blackett apparently blames the President for failing to read the United States Strategic Bombing Survey—a document which had not yet come into existence. All the evidence shows that Mr. Truman ordered the two bombs to be dropped in the sincere belief that they would obviate a land invasion and save hundreds of thousands and perhaps millions of lives. Personally, I think that this belief was not mistaken and that many an American, British, Russian, and Japanese boy is alive today solely because the two bombs gave Japan a face-saving pretext for capitulation.

Is it not a shame that no Russian apologist for America dares express himself inside the Soviet Union? Is it not sad that no Russian apologist for America may stress our refusal to annex a single inch of territory from the defeated Axis countries? That no Russian apologist for America may tell how we demobilized our vast armed forces almost overnight? That no Russian apologist for America may describe our offer to give up the atomic bomb, to admit Russian inspectors inside our borders, and even to allow foreign operation of our atomic factories? It offends my sense of justice that apologists for the Kremlin, such as Dr. Blackett, can appeal to Western opinion, whereas apologists for the West may not so much as whisper in Russia.

I imagine that the Russian people, if they knew the details of the United Nations plan and were free to discuss it, would quickly scuttle Dr. Blackett's criticisms and would join hands with us to achieve the blessedness of real atomic peace. The number one task before us, therefore, is conquest of the Iron Curtain.

An English Scientist Exposes Atomic Diplomacy

M. Marinin

The following is a translation of passages from a review which appeared in Pravda, *November 22, 1948.*

ALTHOUGH Professor Blackett's *Military and Political Consequences of Atomic Energy* has only recently appeared on the English book market, it has already been subjected to an angry cannonade by a whole group of bourgeois hack-writers. An organized campaign is being waged which can be traced directly to the leading authorities in the Labor and Conservative parties.

Blackett's book possesses the unquestionable advantage of refusing to follow the fashionable "theories" of the Anglo-American press about the importance of atomic energy as a decisive military factor. More than that, it convincingly proves that these theories derive their questionable wisdom from sources whose bankruptcy was so clearly shown in the course of the Second World War. Blackett closely investigates the question whether or not the special character of atomic weapons justifies even remotely the delirious bragging of the newly-converted admirers of the "lightning war." His conclusion is that despite the piercing noise of the atomic imperialists, the atomic bomb can by no means play the role of a decisive universal weapon which will all but destroy the value of ground forces. Blackett rejects the fantasies of militarist propaganda concerning the "exceptional effectiveness" of atomic bombs against morale. Therefore, he says, although atomic bombs are a method of mass destruction and a barbarous weapon of aggression, they cannot play a decisive role in the outcome of a war. The ruling circles of the United States and England always lose their self-control in discussing the role of atomic bombs as weapons of psychological warfare. After all, the whole atomic diplomacy is largely based on "psychological terror."

The most open expression of atomic diplomacy can be found in the so-called "Baruch Plan." How many pious phrases have accompanied the publication of this document, which incorporates the far-reaching plans of atomic imperialism! Its author, an old-time, wily speculator from Wall Street, has been glorified by Anglo-American propaganda as a new Messiah, allegedly bringing peace and prosperity to nations. Blackett washes off this deceptive greasepaint. He writes: "The world-wide campaign attempting to present the Baruch Plan as a most magnanimous offer must be considered as part of the Anglo-American diplomatic offensive usually designated as 'cold war', rather than as an honest attempt to reach an agreement."

Blackett confirms the suspicion that the purpose of the Baruch Plan is not merely to retain for the United States the monopolistic possession of atomic bombs, but also to transfer into American hands the world resources of atomic raw materials. If the Baruch Plan had been carried out, the United States would have become the complete atomic boss, and the economies of all countries would be dependent upon America.

BLACKETT explains in detail why, if the international control organization is based on the Baruch Plan, it will inevitably become an instrument of United States supremacy: "The United States Government would not have offered such a plan if it were not completely certain that the votes of the Western nations would form a majority in the atomic control body." These votes the Americans consider, not without reason, as being in their own pocket. Furthermore, the Baruch Plan is constructed in such a way as to guarantee to the United States the possibility of retaining the existing stockpile of atomic bombs, and even increasing it, under the cover of an international organization. Finally, it endows the international organization with the right to delay the development of atomic energy plants wherever it so desires.

Blackett arrives at another very important conclusion: To the extent to which the United States, according to its control scheme, becomes complete master of a world atomic trust,

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CONGRESS AND THE ATOM

Herbert S. Marks

Mr. Marks, formerly General Counsel of the Atomic Energy Commission, is now engaged in private legal practice in Washington, D. C. "Congress and the Atom" has been prepared by the author for publication in the **Bulletin** from an article which he contributed to the **Stanford Law Review.**[1] This article is a sequel to "The Atomic Energy Act: Public Administration without Public Debate," printed in the **Bulletin** in September, 1948.

WHILE Americans may not always like to be judged by the record of Congress, that institution is nevertheless one of the mirrors of national behavior. In the case of atomic energy, the image is, in the main, a hopeful one.

In the chronic disposition to think ill of politicians, it is doubtful that the country fully appreciates how extraordinary were the first achievements of Congress in this field. Passage of the McMahon Act, Congressional sanctioning of the Baruch plan, Senate confirmation of Mr. Lilienthal and his associates on the Atomic Energy Commission together constitute a record on the atom as notable as that of the much lauded bipartisan foreign policy.

It serves only to enhance the credit due the Congress that all these actions took place in response to the insistent demands of the public for just such action as the legislature took. Now, however, the atmosphere of dramatic conflict which accompanied these events has largely disappeared. During the past two years, atomic energy has become the subject of the relatively prosaic task of administration. To assess the record of Congress for this more recent period—which it is the purpose of this article to do—one must leave the newspaper headlines and turn to the fine print of Congressional hearings and reports which tell the story of Congressional committees—the institutions through which nine-tenths of the work of the legislature is done. Of these the most important is the Joint Congressional Committee on Atomic Energy.

I

LIKE the Atomic Energy Commission, the Joint Congressional Committee on Atomic Energy was created by the McMahon Act. It was designed to focus Congressional responsibility, share all the "secrets," keep the Congress informed, and act as the "watchdog for the American public and for the Congress" over the Commission, "potentially the most powerful agency in the history of this Government."

Joint committees are of course no novelty. But never before had Congress concentrated in a joint committee such broad statutory powers: the permanence of a standing committee; jurisdiction over legislation in a broad field; permanent powers of inquiry over a broad subject; and the authority to keep itself "fully and currently informed" about—and therefore intimately involved in—the daily operations of an important executive agency.

In the past eighteen months, the Committee has had more than forty secret executive sessions. These meetings are usually held in company with representatives of the Atomic Energy Commission. Almost nothing is made public about them beyond cryptic entries printed in the Daily Congressional Digest.

During the same eighteen-month period the Committee has issued a "First Report," a long majority and minority report on the Extension Bill (discussed presently), and a relatively unimportant special report of its inquiry concerning a local dispute over a Commission land acquisition.

The First Report gives the clear impression that all the activities of the Commission are carefully watched to assure that the vast atomic energy program is being properly conducted. But the Committee makes no claim that its work or its reports provide the information which the rest of the Congress or the public can use to arrive at their own judgment of the effectiveness with which the enterprise is being carried on.

Because of secrecy necessary to preserve knowledge essential to the production of atomic weapons (a Joint Committee Report regretfully explains), the operation of this vast set-up is clothed with restrictions and mandates for security, and the opportunity for public examination and evaluation of its progress and of the impact of its activities upon our normal peacetime or even potential wartime economy are non-existent. This situation is unique in administrative policy of our nation. It places solemn responsibility on your joint committee.

The statement just quoted is taken from the report by the majority of the Joint Committee on the bill to extend the terms of the members of the Atomic Energy Commission to 1950. Under the McMahon Act, as originally passed in 1946, the commissioners first appointed were to hold office for a kind of probational term of two years; thereafter the President was to make regular appointments. In April 1948, President Truman, acting under this authority, sent to the Senate the renominations of Mr. Lilienthal and his four associates. Mr. Lilienthal was appointed for five years and would have been continued in office until August 1953, several months after the end of the next national administration.

THE Republican leadership of the Joint Committee countered with a bill to extend the terms of the five commissioners for another two years, thus confidently reserving for the President elected on November 2, 1948, the right to appoint all members of the Commission during his administration. The Joint Committee (in contrast to the rest of the Congress and the public) had the inside facts about the Commission's operations. Expressly relying upon this information (but saying that the need for secrecy prevented disclosing it), the majority report described in a very general way certain areas in which there were said to be unsettled questions relating to the Commission's operations. Disavowing any intention of criticizing the Commission, the report emphasized that these unsettled questions were referred to merely to support the conclusion that the original period of two years'

[1] The writer is indebted to Anne W. Marks, formerly a member of the United Press, Special Services Bureau, whose research and perceptive evaluation of materials made this article possible. Documentation is given in the *Stanford Law Review*, for November, 1948, where this article originally appeared.

probation should be continued for another two years.

The Committee's Democratic minority filed a dissenting report which acknowledged that "unfortunately but necessarily the cloak of secrecy must obscure much of the Commission's work from public view." The minority insisted, however, that "the main outlines of the Commission's accomplishments" were clear. They complained that no public hearings had been held, and urged that the Senate reject the extension bill and confirm the President's renominations. The minority suggested that the recommendation of the Republican leadership was motivated by party politics.

Despite the sharp division between the majority and minority, their reports provoked little public discussion or Congressional debate. The extension bill was passed in the closing days of the 80th Congress; the President signed it with an accompanying statement deploring the failure of Congress to confirm his renominations, but characterizing the extension as a lesser evil than recess appointments.

This bill was the most important legislation on atomic energy which confronted Congress in 1948. As to the merits of the issue, it would be extremely difficult for anyone to decide for himself on the public record how the question ought to have been disposed of. Lacking access to the information available to the Joint Committee, an outsider cannot say whether the uncertainties cited by the majority in fact justified the continuance of the provisional status of the Commission, or whether these uncertainties were a convenient device (as the minority argued) conjured up to disguise Republican hostility to a Democratic President's appointments.

IN JUDGING the issue, outsiders have little more to go on than their confidence in the majority of the Joint Committee, on the one hand, or in President Truman and the minority on the other. If there were no help for this situation, it would have to be conceded that in the administration of atomic energy affairs the democratic process must be abandoned. For it is certainly a repudiation of that process if most of the members of Congress and the entire electorate must form judgments on important national issues not on facts but on faith.

Thus far, most of Congress, the press, and the public appear to have accepted this situation as unavoidable. Their attitude appears to be that no practical means exist by which the special problems associated with the atomic energy enterprise can be subjected to public examination in more or less the same manner as other public business.

Fortunately, there are signs—still sporadic but nevertheless definite—that Congress has ingrained habits that run strongly counter to this attitude. Even while the majority of the Joint Committee speaks with seeming resignation of a situation "unique in the administrative policy of our nation," that Committee and other Congressional bodies are finding it necessary to put into effect conventional practices which give some promise of a change in the present conditions.

II

DURING 1947, a labor dispute developed between the Commission's industrial contractor at Oak Ridge and his employees. The controversy was noted by the Joint Committee in its First Report in January, 1948, and at the same time it began to appear that other committees of the Congress might assume jurisdiction to hold hearings on the matter.

Thereupon, the Joint Committee itself announced that it would hold public hearings on the problem. In the ensuing proceedings, the Commission, the contractor, the unions, and the Director of the Federal Mediation and Conciliation Service appeared, gave testimony, and were questioned at length by the Committee.

The published hearings are highly informative. They provide the first clear exposition of the philosophy of the Atomic Energy Commission in its novel relations with industrial contractors and their employees. They present for the first time the history of labor relations in the atomic energy enterprise and a picture of the peculiar conditions that now exist for the industrial contractors and their employees at these secret installations. They reveal also important differences of opinion on these matters among those concerned.

These are extremely useful items of evidence for anyone interested in the general policies of the Commission or the conditions of employment for the approximately sixty thousand people who work in this new industry. It is not the purpose here to evaluate or discuss this evidence. The essential point is that it is now publicly available. More important, the transcript of the hearings demonstrates that vast areas of information concerning the project can be probed by normal democratic methods without threat to security.

The report of the sub-committee of the Joint Committee which investigated the Commission's selection of a site for its Argonne Laboratory is another case in point. This is the report, previously mentioned, which relates to a relatively unimportant local dispute. But the public investigations upon which the report was based have an intrinsic importance: here again there is a demonstration that the affairs of the atomic energy project can be probed by conventional means of inquiry without jeopardizing security.

Not much significance could be attached to these two special inquiries of the Joint Committee if they stood alone. They touch only a small fraction of the very broad spectrum of problems with which the atomic energy enterprise is concerned. Even a reading of all the official published reports about atomic energy gives only a dim sense of the importance, the complications, and the implications of most of these problems. But from their substance a reader should sense that the raw materials for public evaluation of the atomic energy program can be made available much more abundantly than is commonly thought. What these government reports lack mainly is the illumination that comes through the process of widespread public examination, reaction, and discussion. The proceedings of the Joint Committee in these special inquiries illustrate one of the vital steps in that process. The proceedings of the House Committee on Appropriations, owing perhaps to its more direct responsibility for government expenditures, are even better illustrations.

III

SINCE April, 1947, the Committee on Appropriations of the House of Representatives has dealt with three major appropriations bills totaling a billion and a half dollars for the Atomic Energy Commission. The public transcripts of the hearings in the House on the three bills extend to several hundred pages.

In accordance with its usual practice, the hearings of this House Committee are not open; representatives of interested government agencies appear in executive session, seek to justify the requested budget, and are questioned by the Committee. Subsequently, but before the Committee reports a bill, the transcript of the hearings is published. These, in the case of the Atomic Energy Commission, contain occasional gaps where

off-the-record discussion was necessary on secret matters. The practice is the same in the hearings on appropriations for the Army, the Navy, the Air Corps, and the State Department, where it is also necessary to inquire into secret matters.

But the material on atomic energy published by the Committee on Appropriations is voluminous and sometimes revealing. For example, nowhere in the official reports of the Commission is it possible to find as good an explanation of the relations between the Commission and the association of nine northeastern universities which acts as contractor for Brookhaven; nowhere will one find a comparable explanation of the system followed by the Commission in awarding its multimillion dollar contracts, or exactly comparable material on the problems of community facilities and housing encountered in the government cities at Oak Ridge, Hanford, and Los Alamos.

IT IS not surprising that these transcripts of hearings are frequently much more illuminating than the Commission's regular reports. No writer of a government report—even if he takes very seriously his responsibility to inform the public—can possibly anticipate all the perplexing questions which an outsider needs to have answered in order to understand and acquire a basis for judgment. The insider looking out often takes it for granted that information which he possesses as a matter of course will also be known to the reader and need not be repeated. The best protection against this form of unwitting concealment is persistent questioning by the outsider who in this process has the advantage of ignorance.

There are, of course, other reasons why hearings clarify the policies, actions, and problems of government agencies in a way that no official report can match. Although witness and questioner may each prepare carefully in advance, meetings that proceed by question and answer will nevertheless have a spontaneous quality that the deliberate and always cautious government report lacks. Reports read in conjunction with hearings on the same subject will be much more meaningful, just as the opinion and findings of fact of the most disinterested trial judge will be more meaningful to the appellate court if read together with the transcript of testimony.

These are all statements of the obvious. The only excuse for repeating them is that, like so much else that has always been self-evident, they seem so often to be overlooked in the case of atomic energy. At the threshold of this "awesome" subject there seems to be a tendency to forget everything one ever knew.

If and when the Joint Committee begins to hold more public hearings or even adopts the practice of the Committee on Appropriations by publishing transcripts of the nonsecret portions of its own closed meetings, there will be an important advance in throwing light on the atomic energy project. Even the cryptic references to the executive sessions of the Joint Committee which appear in the Daily Congressional Digest indicate rather clearly that these meetings must include discussion not only of secrets but also of much nonsecret information. The fact that such meetings occur suggests that both Commission and Committee find discussion of many nonsecret matters essential to understanding, just as the Committee on Appropriations finds executive hearings essential to an understanding of budgets. Press and public would be assisted in arriving at their own independent understanding by enlargement of the opportunities for vicarious participation in these discussions about atomic energy through more frequent open Congressional hearings or through published transcripts of executive hearings.

IV

THE proceedings of the House Committee on Appropriations also disclose considerable conflict between that Committee and the Atomic Energy Commission. On each occasion when a Commission appropriations bill has come before the Committee, the latter has responded with a generous grant of funds. But in all three hearings and in two of its legislative reports the Committee on Appropriations has severely criticized what is variously described as resort to "glittering generalities" in support of budget in place of facts, "general extravagance" in expenditures, abuse of the Commission's "strategic position in modern military defense to avoid facing the practical realities."

Naturally enough, the Commission has resented the Committee criticism. But, however unjust many of the complaints may be, they have already produced consequences in the public interest. For example, bad accounting procedures in the operations of the project, which came up to embarrass the Commission during the first appropriations hearing, in 1947, were in the course of correction by the time of the second, early in 1948. Stung by the Committee's complaints, the Commission had in the interval employed five private accounting firms to survey a number of its major accounting problems and assist in solving them.

The conflicts between the Commission and the Appropriations Committee, thus recorded in the hearings and reports of the latter, are a sign of the growing pains of the Commission as it acquires experience and digests its confusing inheritance from the Manhattan District. They are a sign, too, of the growing pains of the Committee as it acquires understanding of the subject matter of this unusual government operation.

THESE conflicts have also another and broader significance as part of the conventional process by which government is kept efficient. They can and should produce valuable by-products in the form of constant improvement in the Commission, in its record and in its relations with the public. For even the opportunity to answer unjust criticism is useful in the process of educating a Congressional committee, the public, and indeed the Commission itself. And when the criticism is sound, it will lead to correction of errors and avoidance of future mistakes. Bad accounting practices which are exposed one year will have to be changed by the next. If there are excessive expenditures for housing or community facilities, they will have to be reduced. The process involves much more than so-called "petty penny-pinching" by Congress. "Frugality makes good cooks."

The process is not without danger. The appropriations hearings contain much that is enlightening; the picture of a responsible committee of Congress seeking to hold an executive agency to account is wholesome. But the hearings also display the usual excessive preoccupation of congressmen with the number of employees in public relations work, the number in personnel administration, the precise distribution of salaries—in short, the usual superficiality that it is difficult for overworked Congressional committees to escape.

From a review of the entire available public record of the Joint Committee, one gets the impression that tensions also exist between it and the Commission not unlike the conflicts

which can be more freely observed in the appropriations proceedings. But the secrecy of most of the Joint Committee proceedings makes the fabric of its relations with the Commission rather hazy. Owing to the absence of open hearings and the unavailability of transcripts and informative committee reports, the nature and consequences of any conflicts cannot really be analyzed and judged.

In the case of the Appropriations Committee, however, the questioning, the holding to account, the criticism and the response to criticism, the description of possible executive mistakes one year and their reported correction by the next, are in large part spread upon a public record. Over the long term the entire Congress, the press, and the electorate are thus afforded a fairly good opportunity, if they choose to take it, of deciding for themselves on the record whether Commission or Committee—or neither—is right.

V

IT WILL take much more than a few open Congressional hearings or published transcripts of executive sessions to bring atomic energy affairs within the compass of the democratic process. Those here described offer at most a small beginning in that direction. The Joint Committee to some extent, and the House Committee on Appropriations in a more impressive way, are starting to show that secrecy is not an insuperable barrier to critical evaluation of the atomic energy program. They are beginning to show that one of the essential forums for examining public affairs, Congressional hearings, is as practical in the case of the Atomic Energy Commission as it is for the Military Establishment or the State Department, agencies which also have many secrets.

The lesson implicit in these demonstrations should not be surprising; for a striking example of the same process attracted the widest possible attention long before Joint Committee or Commission was established. The extensive public hearings of the Senate Special Committee on Atomic Energy, brilliantly conducted by its chairman, Senator McMahon, in the latter part of 1945 and early 1946, provided the basic facts necessary for the Atomic Energy Act itself. These proceedings (all except a few sessions were public) developed the facts so well that the Committee was enabled to shape a complicated law, and Congress and the public were enabled to appraise and pass upon it. Experience is already proving the soundness of the law and the adequacy of the essentially nonsecret foundation on which it was built.

The more modest demonstrations of the past year and a half will have to be multiplied and intensified if Congress as a whole is to influence and shape future atomic policy. Even more important, unless such developments in the Congress are complemented by public participation comparable to that which prevails for other public affairs, Congress could become more destructive than useful. Unless public and press direct their influence upon Congress, there will be no public accountability in any democratic sense. We should be grateful to the Appropriations Committee for its open efforts to make the Atomic Energy Commission conform to the same requirements of accountability as any other government agency. But no Congressional committee, unchecked by a vigilant public opinion, is calculated indefinitely to produce decisions adequate for the nation's needs.

The system of checks and balances depends upon the vigorous functioning of all branches of government. Above all, it depends upon an alert, vocal public. In the first formulation of policy on atomic energy, the forces of public opinion asserted themselves with telling effect. Without these pressures the McMahon Act, the Baruch proposals, and the Lilienthal confirmation would have been impossible. The record of Congress in these matters is proof that the will of the people can make itself felt; that the institutions of government can be faithful and adequate to translate the purpose of the electorate into finely integrated instruments of policy and action.

THE detailed records of the Joint Committee on Atomic Energy and the House Committee on Appropriations should also testify to the capacity of government institutions to accommodate themselves, without violence to traditional processes, to the special conditions of a new, complex, and often secret subject. Through the operations of these committees, Congress is beginning to play its appointed part in the grinding process by which the Government is made accountable to the public as a whole. It is some measure of how well the legislative institution has been built that Congressional practices rooted in a century and a half of history assert themselves to promote that process even though neither Congress nor the public is yet fully alive to the necessity for or the feasibility of accountability in atomic affairs.

Hafstad Named Director of Reactor Development Division

The U. S. Atomic Energy Commission announced on January 16 the appointment of Dr Lawrence R. Hafstad as Director of its Reactor Development Division. He is the first director of this division, which was created in August, 1948, to carry out the program of designing and developing nuclear reactors for the practical application of atomic energy for power, for propulsion of ships and aircraft, for production of isotopes, and for research on reactors themselves. It is principally through development of reactors that the AEC expects to develop a means of utilizing the energy released by nuclear fission.

Dr. Hafstad is on leave of absence from John Hopkins University. With two colleagues, he demonstrated uranium fission for the first time in the United States in 1939.

Since July, 1948, Dr. Hafstad has been executive secretary of the Joint Research and Development Board of the National Military Establishment. He was awarded the Medal of Merit by the Secretary of the Navy in 1946 for his wartime activities in connection with the development of ordnance devices.

Westinghouse to Construct Reactor for Ship Propulsion

The USAEC has entered into a letter contract with the Westinghouse Electric Corporation of Pittsburgh, Pennsylvania, for the construction of an experimental nuclear reactor for eventual use in ship propulsion. The project will seek to meet requirements set by the Navy Department's Bureau of Ships.

The Argonne National Laboratory, the major center of the Commission's reactor development program, has responsibility for the development of the reactor, but its detailed engineering, construction, and operation have been delegated to Westinghouse.

CHEMICAL ASPECTS OF THE ATOMIC ENERGY PROBLEM

F. H. Spedding

Mr. Spedding, one of the outstanding chemists in the Manhattan Project, is now Director of the AEC's Atomic Research Institute at Iowa State College. In a speech delivered before the Electrochemical Society in New York on October 15, 1948, he discussed the technical problems faced by chemists engaged in atomic research and the relation of science and security. This article is a condensed version of his speech.

I SHALL summarize for you some of the chemical problems associated with the design of a power pile. For obvious reasons of security I cannot give you any details in a talk such as this as to how far we have progressed in these problems, but I can pull together the various types of chemical problems which I am sure many of you could think up yourselves if you gave thought to the matter, and which have to be solved if a successful power-pile is to be built.

First consider the fuel rods. Thorium and uranium are the known sources of fissionable materials which are generally available, but a great many problems arise as to how to fabricate these. What shape should they be? How do you produce them in quantity in the desired shape? How pure should they be? How do you produce the material of required purity? Should they be pure metal or alloys, and if alloys, which alloys?

It should be pointed out that the nuclear properties in regard to neutrons determines which alloys can be used as well as the chemical properties of the metals employed. This frequently means that metals which have heretofore been commercially rare may be in demand, and the electro-chemical industries may play an important role in producing good metal of these lesser known elements in high purity.

Further, these fuel rods have to be cooled if very much heat is to be taken out, and the problem of corrosion enters. Some alloys will take higher temperatures or withstand corrosion much better than others, and the choice of which one to use in a given reactor design depends to a great extent on our knowledge of how these alloys behave under the conditions required in the design of the reactor. Also, I might mention that the fuel rods do not necessarily have to be metal but may be refractories which have good heat-conducting properties, or even liquids. I might also mention that stainless types of alloys would be very desirable or that in some cases it is necessary to encase these materials in cans or coated metals which also possess good heat-conducting properties. Here again the electrochemical industries can play a major role.

The fuel rods may be enriched with fissionable atoms such as U-235 or plutonium 239 and the more the enrichment, the smaller the design of the reactor. Further, as the fuel rods react, the uranium in fission produces other metals and atoms which tend to change progressively the property of the alloys present, and some of these may maintain their physical strengths far longer than others.

The coolants can be of many types. They may be air, rare gases, metal alloys, organic liquids; and it must be remembered that the nuclear properties of the atoms being used must be desirable. These coolants must be capable of transporting the heat generated, and they must not be corrosive to the elements of the pile. Here again, materials which have been slightly too expensive to take hold commercially may become important through their nuclear properties, and new industries for producing them may develop.

The moderators can be of various types, such as graphite, heavy water, beryllium or other light atoms; they also must withstand temperatures, radiation and corrosion.

Finally, the shields must be able to withstand all these reactions. Further, as the pile gets larger its weight increases, and the thinner we can make the shields the more feasible it becomes to put a reactor in an airplane or a ship. It is all very well to use a thick wall of concrete, but the shields of the future undoubtedly will contain many new types of alloys and ceramic materials which will permit them to be much thinner than the ones now in use.

The control rods can be made of various substances and here again new metals, alloys and ceramic materials with special properties of being able to withstand radiation, corrosion and high temperatures will be in great demand.

The pile also has to be monitored for the level of radiation with regard to neutrons, electrons and gamma particles, and these new materials of very high purity will again be in demand for producing the instruments of the future for the control of these operations.

If the piles are to operate as power-piles, the fuel rods will have to be removed from time to time and purified in regard to activity of neutron poisons and placed back in the piles, and this means the construction of chemical equipment which can operate simply by remote control and which will withstand radiation, corrosion and heat. Here again the electrochemists can play an important role in producing this equipment and giving it surfaces which will withstand the reactions and even in helping devise remote control processes for carrying out these operations.

I SHOULD like to point out at this time that as new processes are developed for producing new alloys, new ceramic materials, and unusual metals of very high purity, these same processes can be used for producing other materials for industry in general. The very pure materials themselves will find many industrial applications which, in the long run, will probably far outweigh their use in nuclear reactors.

I believe it is obvious from what I have just been saying that as vari-

ous types of power-reactors are developed in the future, greater and greater use is going to be made of elements of the periodic table which are not generally available commercially in quantity and in the forms desired. These elements will be demanded in the construction due to their peculiar nuclear or chemical or physical properties. Many of them are reasonably abundant in nature but due to lack of commercial demand have never been systematically studied for the purpose of producing them cheaply and in quantity, nor with great purity. Those which are available are usually by-products of other processes. As these lesser known elements are demanded in various metals, alloys and compounds, new industrial processes will have to be developed to produce them starting all the way from the concentration of the ores, through the refining, right up to the fabrication of the finished product in the desired form.

The Ames Laboratory of the Atomic Energy Commission, of which I am the Director, has devoted a considerable part of its effort to the pioneering type of research where these new materials are tried and has produced a considerable number of special types of metals, alloys and chemicals of extremely high purity to see whether these new materials are useful for reactor development.

AS AN example of this type of development, I might mention the rare earths. As you know, these elements are not really rare in nature but are called the rare earths (1) because they occur widely scattered throughout matter, generally in low concentrations and (2) because of the extreme difficulty in separating them from each other. The older fractional crystallization methods of separating them required years of labor to produce nominal quantities, and few chemists had the patience, interest or drive to do this. Therefore, the literature concerning the properties of the metals and alloys of these compounds is limited.

However, as mentioned previously, when uranium fissions it produces two radioactive atoms of lighter atomic weight. This break may occur in many ways so that in a bar of uranium which has been ten per cent fissioned, you will find some forty elements present among which occur rather prominently various members of the rare earths. Some of these have very bad neutron properties, so it became desirable to obtain the rare earth metals and compounds in pure form to study their nuclear properties.

As reactors are built it will be necessary to remove some of the rare earths from the pure materials and it will be desirable to see what the effects on structure of various percentages of rare earths are in the fuel material. Therefore, we have obtained these materials for experimental studies.

THE Ames Laboratory developed a process involving adsorption columns, on the water-softening principle, where the separation of these rare earths could be greatly speeded up, and we have succeeded in producing a number of very pure compounds of these elements. We have also produced the pure metals of a number of them, such as Ce, La, Nd, Pr, Y and Th and Be.

It is possible to design reactors in many ways, and the problem of design in each of these reactors requires the combined efforts and knowledge of almost all kinds of scientists and engineers. Basic discoveries in all the fields of physical chemistry, metallurgy and engineering will have to be drawn upon to make the practical applications, and almost any scientific fact in these fields may prove useful in the practical applications of atomic energy.

It points up the fact that this country, for its own national security and safety, will have to draw a very careful line as to where secrecy does our own country more harm than it could possibly do good by withholding information from a potential enemy.

I have given a good deal of thought to the subject of "just what is our atomic secret?" You all know that it is not a formula which can be readily purloined by a secret agent to be turned over to an enemy. Actually, almost all the fundamental principles and basic knowledge which are needed to understand the operation of an atomic bomb or an atomic engine were known before the war by scientists of all nations, had been published in the scientific journals of these nations, and are therefore available to anyone who has sufficient scientific background to pursue the subject and who cares to take the time to do so.

Therefore, the real secret of how to produce an atomic bomb or an industrial power plant lies in the extensive scientific and industrial know-how which our scientists and engineers possess as part of their heritage and education. The real secret is not in *how* the bomb or power plant operates, but in how to carry these operations out on a large scale so as to make them effective.

Every boy who has had high school physics knows the principles of the electric generator but this is a long way from being able to manufacture a 50,000 kilowatt generator such as is used at Niagara Falls. Here the real secret is in the technical know-how of how to produce this generator, and this secret is spread among many individuals in many professions such as miners, metallurgists, electrical engineers, chemists, physicists, etc.; no single man, if he wished, could give away the entire secret.

So it is, to a much greater extent, with the so-called secret of the atomic bomb. You all know that new scientific discoveries or inventions are not the results of "flashes of genius" where the discovery or invention springs full-grown from a void, but are almost invariably the results of methodically building upon and extending the work of others, and that the real brilliance occurs when a scientist or engineer perceives a new way to extend or twist the data so as to get the results desired. This process is greatly accelerated when the men working on the problems can get the benefits of talking over their work with other people interested in these fields, and the best ideas frequently result from the clash of ideas on ideas.

THE compartmentizing of scientific knowledge tends to sterilize science because it tends to cut down the cross-fertilization of ideas which is necessary to its healthy growth, and therefore I think this country is in serious danger, from the national safety angle alone, of losing its lead in the scientific world due to the emotional approach to the question of secrecy which is so prevalent in certain quarters of our society. I am convinced that if we were certain that the next war was more than twenty-five years away, by far the smartest move that could be made in the interest of our national safety would be to make *all* information concerning atomic work completely free. I am sure that if the Germans had had complete details of our airplanes and cannons of 1917 in the beginning of World War II they would not have been of much use. I

feel confident that our scientists and engineers, if unhampered, can keep well ahead of those of any other nation.

On the other hand, in the present world situation we cannot be sure that the next war *is* twenty-five years away, so it is necessary for our national safety that we do retain certain atomic secrets until an international order is set up which can police the world. There is no question in my mind that military matters, the design of weapons, and the design of larger scale production plants should be kept secret until a workable international control scheme has been put into effect, but what ought to be made public should be left to the scientific and technical people and not be determined as the result of emotional ignorance.

I FEEL that we are in real danger of losing our world leadership in science and engineering if so much secrecy is placed upon these subjects as to seriously hamper our future progress in these fields, and this hindrance can result just as much from an indirect pressure as from a direct one.

For example, if scientists and engineers are frightened into remaining silent about those phases of the subjects which are not real secrets—by witch hunts or by public pressure stemming from ignorance—then these phases will lag, and in the long run this will do serious harm to our country.

One might say that the telephone book or publications such as *The American Men of Science* or *Who's Who* would prove very useful to the enemy in that it would enable them to quickly locate our key scientists and engineers. On the other hand, I don't believe anyone would take the position that these books should be stamped "Secret." It is obvious that the usefulness of these volumes in their unrestricted category far outweighs any good which could be achieved by withholding them from the enemy. The same is true of all the fundamental branches of science and I think it is very important that we all give a strong support to the Atomic Energy Commission in its effort to free large areas of scientific investigation. It is evident that we are taking a calculated risk in doing this, in that someone in one of these fields might discover a fact that would be of great benefit to a potential enemy, but I feel that any harm resulting from this calculated risk is insignificant compared to the impetus which a free science in these fields would give to our scientific development. I believe that we can depend on the patriotism of our scientists and the editors of our journals, to see to it that in almost any case where such a leak might occur, this information would be withheld. Of course by this I do not mean that everything should be made public. There are certain fields such as weapon design, production processes, etc., where in the troubled world situation it would be desirable to have all information examined before it is released, but I think these fields should be strictly limited and great care should be taken that we do not let unintelligent secrecy destroy the processes by which our industry and science have become great.

I believe a chemist is allowed one wild dream in making his predictions, and I would like to point out the very intriguing possibility of converting nuclear energy directly into electricity. All the present proposed applications of converting nuclear energy into useful energy go through the process of fission producing heat and then generating electricity, and of course, as you all know we are limited by the thermodynamic efficiency. If a process could be found to take electricity directly from the pile, as we now take electricity directly from chemical reactions, then a great milestone would have been passed in science's march of progress.

English Scientist Exposes Atomic Diplomacy

(Continued from Page 43)

in possession of a stock of atomic bombs, a strategically located network of power plants, and a corps of inspectors, it can prevent any development of atomic industry inconvenient to the atomic bosses, even if this development be directed toward completely peaceful purposes. He concludes that acceptance of the Baruch Plan would create conditions under which any infringement, real or imaginary, could be used by the majority as a pretext to start a third world war.

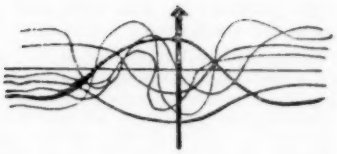
No honest believer in peace and security has the moral right to neglect this assertion by an English scientist, which indicates that the Baruch Plan is a truly nefarious instrument for the preparation of war and for the destruction of international cooperation and peace.

IT IS probably because of this very meaning of the Baruch Plan that the representatives of the United States, as well as of Great Britain, are adhering to every letter of this plan, and show no inclination to make any concessions whatever. Blackett sees in this stubbornness the main reason for the present deadlock in the atomic control negotiations. He contrasts with these tactics of the representatives of atomic diplomacy, the line taken by the Soviet government, which tries to find a way out of the deadlock.

In investigating the control of atomic energy as part of the general problem of world cooperation, Blackett gives a devastating criticism of another "theory" also fashionable among the adherents of atomic diplomacy—the theory of "world government." The adherents of this theory ask the nations in the United Nations to renounce their national sovereignty in favor of an alleged "world government," which means, in fact, in favor of the United States, which, as a monopolistic atomic boss, will in fact be the "world government." In this way, international cooperation is replaced by American dictation. Blackett characterizes these opinions as absolute nonsense. He writes: "The problem of the preservation of peace in the whole world, although it has been made urgent by the invention of the atomic bomb, has not changed its nature." It follows that the necessity for international cooperation, particularly cooperation between the great powers, has enormously increased. Blackett underlines the first-rank importance of the unanimity rule in the Security Council. "This rule is the guarantee against the possibility of utilizing the United Nations for the legalization of a third world war."

Blackett's book contains erroneous opinions which show the influence of various prejudices, but these deficiencies cannot obscure its essential virtues. His pronouncements and those of certain other English scientists who criticize the American and British policy in the atomic energy field, are witness to the fact that the position of the Soviet Union, which urges the prohibition of atomic weapons and the establishment of strict control over the implementation of this decision, alone answers the interests of peace and security.

REPORT OF AEC INDUSTRIAL ADVISORY GROUP



The Industrial Advisory Group, appointed by the AEC in October, 1947, to study ways in which industry might increasingly participate in atomic energy development, submitted its report to the Chairman of the Commisson on December 22, 1948. The Group was headed by James W. Parker and included the following members: Bruce K. Brown, Gustav Egloff, Paul D. Foote, Isaac Harter, Sr., Jerome C. Hunsaker, Gabriel O. Wessenauer, and Robert E. Wilson. Mr. Walter Cisler, a previous consultant to the Commission, worked closely with the Group in its survey. The **Bulletin** here prints a condensed version of the Report. Sections III and IV are reproduced in full; Sections VI and VII, discussing the strengthening of the contract system and suggesting changes in Commission organization have been omitted for reasons of space.

THE Industrial Advisory Group, established by the Atomic Energy Commission as an advisory board under Section 12(a) of the McMahon Act of 1946, was requested to survey the Commission's activities and make recommendations for increasing industrial participation in the atomic energy project. Specifically, the Group was asked to help the Commission in developing a program with the following purposes:

1. Utilize fully the Nation's industrial research and development capacity;

2. Keep the industries directly concerned fully informed as to the developments in their fields; and

3. Insure opportunities for technical training in atomic energy of as large a part of American industry as possible to prepare the industrial community of the Nation for the job it must do if America is to be strong in atomic energy.

The Commission has given us access freely to all necessary documents, personnel, and installations. In reaching our conclusions, we have taken full account of much secret information about the project, but we have found it possible to avoid detailed reference to such matters in our report.

We emphasize this at the outset because, despite the excellent cooperation afforded by the Commission, one of the serious obstacles in making our survey arose out of burdensome security regulations. Difficulties in connection with clearances, the complicated mechanics of arranging for access to people and installations, the elaborate procedures for the safekeeping of notes and documents, as well as other secrecy restrictions, together constitute a formidable impediment to any attempt to study and understand the enterprise.

We mention this circumstance not at all as a criticism of necessary security policies, but because the need for secrecy creates a fundamental unsolved problem in dealing with the subject.

At present, the barriers to increased industrial participation, caused by secrecy and other fundamental difficulties, cannot be removed. But we believe, as will appear presently, that the Government can reduce the barriers and help the industrialist to cope with the difficulties. The Industrial Advisory Group is unable to suggest any simple formula that the Government might adopt to this end. In our opinion, however, adoption of the recommendations which are discussed in this report would lead in the right direction.

While our suggestions appear modest in comparison with the magnitude of the problems, it is important to observe, nevertheless, that most of the things we propose are not now being done on a broad and intensive basis. We believe that if our recommendations in this respect are followed and a program to that end is developed and vigorously pushed, both the Commission and American industry can look forward in the not distant future to a significant expansion of industrial participation in atomic energy development.

I. Present Role of Industry in Atomic Energy

The Atomic Energy Commission has made commendable progress in carrying out its responsibilities. The contract system, which it is continually seeking to strengthen, already gives industry an important part in the program.

In only one important area, nevertheless, is there any independent industrial activity. Radioactive and stable isotopes which the Commission is making readily available, on short notice, in reasonable quantities and at reasonable prices, are being used increasingly for industrial research and metallurgy. Their importance in helping to reveal new knowledge would be hard to overestimate.

But our study confirms the judgment of the Commission which led to the setting-up of this advisory group: there is an unmistakable need for greatly expanded participation by industry in atomic energy development. We recognize, of course, that in this new field of technology it is difficult to predict precisely which of the many American industries will have a direct interest in developments. But it is certainly true that some of the most important branches of industry are likely to have a direct potential concern with atomic energy. Among these are the chemical, petroleum, power, heat-transfer equipment, metallurgical, and instrument industries. And our observations during the past months bear out the warning of the Chairman of the Commission at the time the Industrial Advisory Group was set up:

Unless the initiative, the technical skills, and the managerial ability of American industry are brought to bear with maximum effect on the problems of atomic energy development [said Mr. Lilienthal], the people of the United States will not realize the full benefits of this new field of endeavor. . . . It is the purpose of the Atomic Energy Commission, and I have no doubt that it is the intention of the Congress, to move away from the present Government monopoly, provided by law, just as

fast as it can be done with due regard for the national security . . . .

When I say there must be the greatest possible industrial participation, I mean not only the contract operation of facilities, to which the industrial skills of the country are already applied. And I mean more than the supplying of services and equipment. We do have more than 3,000 contractors and subcontractors and major suppliers taking part in the program and this number will be increased.

We must find opportunities for industrial participation — that is, opportunities for profit. We must develop incentives to industry to get into this field. We must carry on a program which will encourage in atomic energy the same kind of competitive effort which has made the automobile and chemical industries what they are today, that competitive effort which keeps all American industry pushing at the frontiers of technology.

II. Need for Increased Participation and Major Obstacles Thereto

The difficulty and the danger in the present situation is that industry's part in atomic energy is very limited as compared with the opportunities which exist and always have existed in other fields. The small number of companies which take significant part are selected by the Government and the extent of their role in the work is limited by specific assignments from the Government.

This condition is unfortunate not only because it runs counter to the conviction widely held to in America that opportunities for the exercise of enterprise, initiative, and ingenuity on a broad scale are essential to national well-being; there is also another and pressing reason for broadening industrial participation. The Commission is faced with a multitude of new technical problems which need to be solved promptly in the interest of national security. These are the very kinds of problems which our industrial system has in the past shown itself to be pre-eminently qualified to solve.

The Commission, for example, is seeking improved methods for finding, refining, and utilizing its basic raw materials. It is seeking improved methods for producing fissionable materials. It is seeking to develop new reactors that will produce power and "breed" more atomic fuel than they use up. Progress in atomic development—for military as well as peaceful purposes—depends on getting answers to questions of extreme difficulty in physics, chemistry, geology, engineering, and metallurgy.

Success in finding solutions for comparable problems in other fields of technology has come about through energetic attack by many competing firms and individuals rather than by any select group. The Commission's contract system—though it includes some of the country's ablest industrial organizations—is not by itself a real substitute for this process.

We think that today the central difficulty in getting a broad industrial attack on the problems of atomic energy is the fact that industry has no way of determining whether important opportunities in fact exist in which to take part. In our view it is a mistake to think that the seeming absence of conventional incentives to business is the main cause of the present situation. While the hope-of-profit motive may be the primary inducement to industry in entering new ventures, much more than the prospect of immediate profit is involved here. The expectation of financial reward even in the distant future—the desire for prestige, and for getting an early start in an important new field—these are often enough. A genuine concern for the Nation's defense would be sufficient inducement to some, regardless of the financial return.

The need for Government monopoly in certain important areas, coupled with secrecy, seems to erect an impenetrable barrier to a wish for knowledge. If industry is to help in atomic energy and benefit from it, industrialists must first be put in a position to find out enough about the subject to determine whether and where there are in fact opportunities to take part. In devising means to this end, only the Government can take the initiative. The Government, which must exercise a broad monopoly and determine security regulations, alone is in a position to open the doors. Industry can, and we are confident that it will, cooperate. But Government must first provide the catalytic forces that will set more of the normal processes of industry to work.

This the Government can do: (1) by providing industry with much useful information about atomic energy, (2) by greatly increasing direct personal contacts between men in industry and the atomic energy project, (3) by setting up and making effective use of various kinds of industrial advisory committees, (4) by further strengthening the contract system and, (5) by perfecting the Commission's form of organization so that it will be in a better position to deal effectively with industry.

III. Additional Reports by and about the Commission

A good deal of information about the Commission's activities has appeared publicly in Commission reports, Congressional hearings, press releases, and articles in the technical journals. But usually the material is not organized or presented in a fashion that makes it really useful to industry. The task of digging the scattered and fragmentary material out of such sources and piecing it together—with understanding and in a usable, organized form—is wellnigh impossible for anyone except members of the Commission staff or groups working under the direction of the Commission.

Moreover, during our survey we received the distinct impression that a vast amount of nonsecret information about the work of the Commission and its predecessor, the Manhattan Engineer District, has never been published anywhere. This type of material can only be made available if the Commission devotes more effort to the task of sorting out the nonsecret from the secret for publication. Frequently this nonsecret information which has not yet been published anywhere is essential to a clear understanding of that which has already been published in some form.

We are aware of the Commission's efforts to develop a broad program for the dissemination of information about atomic energy. This program, which wisely places a heavy reliance on various types of publishing agencies outside the Government, is valuable and should be vigorously pursued. We think, nevertheless, that the efforts thus far have not been focused specifically enough on the problem of educating industry. Scientific information appears to be made available by the Commission in a manner adequate to keep interested scientists informed. But the availability of additional material—in a form useful to industry—is indispensable to getting industrial participation in atomic energy.

Industry requires information along two quite distinct lines. First, it needs much additional technical and semi-technical knowledge about the

whole field of atomic energy. Such information will help in clarifying and identifying the opportunities which atomic energy potentially affords to industry.

There is a second class of knowledge which must be made available in order to complement the first: information about the structure of the Commission, its administrative policies and its procedures. The better industry is informed about these matters, the better it will be able to deal with the Commission with assurance and understanding. The general atmosphere of secrecy which surrounds atomic energy has enveloped this kind of information—even though most of it is nonsecret—almost as completely as technical matters.

Technical and Semi-Technical Information.—As an illustration, there is already a conspicuous example of the first type of informative action, in which the Commission has proceeded wisely. In our preliminary discussions with them last June, we stated our favorable impression of the Commission's radioisotope program, but expressed the opinion that the activity of industry would be speeded up if knowledge of what the Commission was doing was made more widely available.

We have been particularly gratified to observe that in the Commission's Fourth Semi-annual Report dated July 31, 1948, a large part of the text is devoted to a well-organized and detailed semi-technical report on radioisotopes. The report, we think, is an excellent demonstration of how the Commission can help industry to recognize and take advantage of opportunities in atomic energy. We urge the Commission to continue the preparation and issuance of such reports and also separate reports on specific subjects which would supplement or be in addition to such reports as the Fourth Semi-annual Report. These separate reports should be characterized by the same kind of discernment in anticipating the questions industry needs to have answered.

We recognize that the publication of Government reports on radioisotopes is much simpler than reports on other technical aspects of atomic energy. But it is precisely in these more secret and less advanced areas of development that it is essential for the Commission to make it possible for industry to become informed. Even as to these areas, we think there is much more that the Commission can do, within the limits of security, to inform industry.

During our survey of the project, we observed, for example, interesting and valuable new metallurgical techniques, new chemical treatments to protect against corrosion, new plastics, instrumentation, and useful technical knowledge of many kinds. This information, although developed in research on atomic energy, is only incidentally related to atomic energy. It is still largely unknown except to those industrial organizations which actively participated in the research through which it was discovered.

We have the impression that for reasons which are not at all clear, much of this knowledge is still buried in the files and activities of the Commission. We think the Commission should make a special effort to publish it—to the extent that military security will permit—at the earliest possible date. The cost of secrecy is high. This is one of the many instances in which we have thought its value doubtful.

Another example of a technical subject on which additional information is needed was also mentioned in our earlier comments on the Commission's work. It was suggested that an engineering analysis of the economic conditions to be met in the production of power from atomic energy would be valuable. We suggested that this analysis might be made on behalf of the Commission by a large industrial organization acting under contract. Another and perhaps wiser approach would be to accept the offer of the American Society of Mechanical Engineers to make such an analysis for the Commission.

In renewing this suggestion, we do not mean to minimize the value of the statement on the subject of atomic power of the Commission's General Advisory Committee, which appeared in the Commission's Fourth Semi-annual Report. The General Advisory Committee statement was useful. But we think that a detailed economic and engineering evaluation of heat energy from atomic fission should be possible without waiting for the development of practicable methods, and of course without violation of security. The study we have in mind would make a careful analysis of all the paths that look feasible for developing power for practical industrial application.

Information on the Commission's Structure, Administrative Policies, and Procedures.—Within this category, there are many examples of topics that would be of special interest to businessmen. From a security standpoint, publications of this type should not present the difficulties which are inherent in those on more technical subjects.

The patent situation is a good illustration. In discussions with industry, our Group has frequently heard great concern expressed about patents. There is a strong impression that the Government's patent policy is prejudicial to industrial participation in atomic energy. Unless the Commission clarifies the situation, hesitancy may continue to affect industrial participation adversely.

A year ago the Commission published a first report, prepared by a distinguished Patent Advisory Panel, which treated the subject exhaustively. But the treatment in that report, however useful to the Commission, has not allayed industrial apprehension. The reason for this is not difficult to find. The purpose of that report, as stated by the Commission in releasing it, was "to recommend policy, procedures, and staff organization implementing the patent provisions of the Atomic Energy Act of 1946." In other words, the report was prepared, not for the education of industry, but for the guidance of the Commission. It has undoubtedly served that stated purpose very well. Another and quite different report is now needed.

The businessman lacks the specially informed background of the Commission which the Patent Panel took for granted in writing its report. To give the industrialist an understanding of the consequences of the present law and the Commission's policies, a patent report must be written for a totally different audience, with little or no background in atomic energy, and with different questions in mind. The manner of its preparation might appropriately be left to the present Patent Advisory Panel. But, as in the case of the report on radioisotopes,

in order to be useful it should anticipate the kind of questions to which businessmen want answers.

A simple but comprehensive report on the Commission's procedure in negotiating, awarding, and administering its numerous types of contracts would also be useful. At present there is considerable fragmentary information on this subject but no well-organized comprehensive report that gives a clear picture of Commission policies and procedure. Education of industry in these matters should help to give effect to the Commission's objective of interesting additional companies in taking on Commission work.

Another question on which industrialists need information is the Commission's labor policy. Unless potential contractors are satisfied that the Commission's policy can be accommodated to the policy which the contractor follows in his labor relations generally, there are sure to be difficulties and a hesitancy to engage in work for the Commission. An informational report by the Commission or under Commission sponsorship could go far to eliminate the misapprehension that now exists in industry on this subject.

The subject matter for reports of value to industry could be extended indefinitely. As we have indicated, in some fields the Commission will profit by getting representatives of industry to prepare the reports under the general auspices of the Commission. In this way, the members of the group will themselves secure a valuable education about atomic energy, just as our Group has. Outside groups of this kind, will, in addition, bring to the work a more direct knowledge of the questions that need to be answered for industry's benefit.

In some areas, on the other hand, members of the Commission's staff will be in the best position to prepare initial reports. This was certainly the case in the recent report on radioisotopes. In still others, the Commission may find it profitable to have a combination of staff members and representatives of industry work together.

However the work is done, it is of such great importance as to warrant the best efforts and talents the Commission can command. A vigorous, well-organized program of reporting on the nonsecret phases of atomic energy for the specific purpose of educating industry would be received with enthusiasm. The reactions to this from industry would in turn suggest new lines of educational work. The net result would be an enlargement of industry's horizon on atomic energy with advantages both to itself and the Commission, and therefore to the public.

What we have said thus far is intended to illustrate ways in which the Commission can take the initiative in facilitating industrial participation by making information about its activities available in useful form. Our own study of the atomic energy project indicates that as yet only a mere beginning has been made in the important reporting activities which are needed to increase industry's knowledge of the subject.

IV. Increasing Direct Contacts with Industry

In this report we have placed primary emphasis upon increasing industry's knowledge about atomic energy. As industry acquires a larger share of organized, detailed information, we think that industry and the Commission, working together, will find many ways of increasing industry's part in the enterprise. But it will take much more than reports to provide industry with the knowledge it must have. There must also be broad personal contact with various phases of the enterprise.

An illustration drawn from our own experience is enlightening. One of our number is at present in charge of an important specific industrial research and development project. Among the knotty unanswered questions in his project is one relating to the type of coolant to be used. During our survey, he observed, firsthand, a unique process that was being worked on in one of the Commission's laboratories to solve a problem which also related to coolants. The Commission's work immediately suggested to him a new avenue of approach to his own special research problem. He remarked at the time that even had he read about the Commission's investigation in the technical journals, the chances are that he would have missed the connection with his own investigations. Direct personal contact with the work in the atomic energy laboratory gave him the concrete experience necessary to see a relationship that he would otherwise have missed.

The experience just described is in itself a rather trivial incident. Yet it is out of a multitude of such trivial incidents, experienced by many people, that the massive forward movement of technology takes place. It is for this reason that we emphasize that the most comprehensive and competent reporting by the Commission will fail of its purpose unless it is complemented by extensive individual, personal contacts between qualified technologists, industry leaders, and Commission personnel and work.

As we indicated above, the branches of industry most likely to be interested in atomic energy are the chemical, petroleum, power, heat-transfer equipment, metallurgical, and instrument industries. Engineers and technologists in various companies in these fields are eager to learn about atomic energy. Many of their companies have no immediate thought of engaging in atomic energy work, but they anticipate that they may become involved as future developments occur. In other areas of technology in which research and development are taking place, these engineers and technologists can without undue difficulty keep abreast of developments. They keep informed not only through the technical journals, but also through their contacts with industrial and university laboratories. In the case of atomic energy, these normal channels are closed to them.

We see no reason why engineers and technologists employed by industries with a legitimate future interest in atomic energy, or those nominated by responsible professional societies, should not be given sufficient clearance in the same way as Commission contractors and employees. It should be made possible for them to discuss developments freely with their professional associates who have been given similar clearance or who are engaged in atomic work under Commission contracts. If such engineers and technologists are required to stand the same kind of investigations and assume the same security obligations as the contractors' staffs, their access to secret information would no more prejudice security than that of the contractor's organization.

Contractors for some of the atomic energy laboratories have had a policy, encouraged by both the Manhattan District and the Commission, of admitting on a consulting basis technologists from other concerns. But this policy has been practiced on a very limited scale. It is only a narrow example of the program we propose. It should be greatly broadened so that qualified and legitimately interested technologists can keep in touch with developments in atomic

energy as they would keep informed of other scientific and engineering developments.

The suggested program will have many benefits. It will provide an opportunity for many technologists from industry to get the concrete, firsthand experience necessary to illuminate the Commission's published reports. Through these direct professional contacts, the outside technologists can also contribute constructive ideas on the problems of those directly engaged in the work—in ways that were frequently evident to our Group.

In developing the details of the program, the Commission should consult with the national engineering and scientific societies. In making its plans, the Commission should also consult directly as many of the interested industrial concerns as possible. But we think that the Commission and its contractors are already in a position to make an immediate beginning in such a program without awaiting its refinement in all details.

Even more important than these intimate contacts between outside technologists and the men presently engaged in the Commission's work, is the development of a parallel program to bring outside executives in close touch with developments. In all of the industries likely to be interested in atomic energy—chemicals, petroleum, power, etc.—there are many men in top executive positions who have an over-all responsibility for technological matters in their companies. Usually these men themselves commenced their careers as engineers or scientists.

The Commission should develop a program to encourage and make it possible for these men to keep informed about atomic energy. There are several hundred such men in industry who should be given firsthand, continuing experience with the subject. But the experience must not be synthetic. The outside technologist—in contrast to the executive—will have a compelling professional interest in technical matters that can make his contact with Commission laboratories fruitful. The executive's interest in detailed technical questions, on the other hand, will ordinarily be more remote. Attendance at special lectures sponsored by the Commission, visits to laboratories, and the like, would have some value for him. What made our own experience so educational, however, was the fact that our survey was directed to a specific end, for which we felt a personal responsibilty. Education was a by-product of our task.

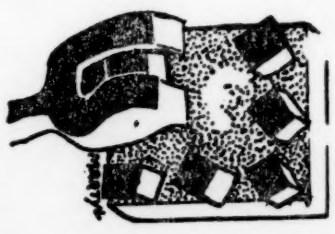
One of the best devices to provide comparable experiences for other executives is the system of industrial advisory committees with which the next section is concerned. Another possible way to bring about purposeful industry contacts would be to encourage the setting up of a corporation owned and directed by a number of able companies in a given field or fields to assume responsibility for some major project.

V. Industrial Advisory Committees

In our discussions with the Commission, we were asked to give consideration to the desirability, scope and make-up of a General Industrial Advisory Committee. We recommend that such a committee be set up in a relationship to the Commission functionally similar to that of the statutory General Advisory Committee.

As to size, our Group favors a somewhat larger committee than the statutory General Advisory Committee, in order to represent the interested industries more broadly than a nine-man body could do. For the purpose we have in mind, a committee with as many as twenty members seems not impracticable. With such membership, balanced representation could be given to different industries and geographical areas. Members should be selected from among industrial leaders with enough technical background and scientific competence to permit them to judge the relative abilities of various technologists employed in their own industry and to comprehend the Commission's basic technical problems. We think that executives of companies having Commission contracts should not be excluded from appointment.

The usefulness of the permanent committee would be enhanced by an organized procedural set-up for communications, reports, and regular, formal meetings with the Commission or its representatives, two or three times annually. The committee, as in the case of the General Advisory Committee, should have a permanent secretary in close contact with the Commission organization to take care of detailed contacts with the Commission.



The Industrial Advisory Committee should endeavor to keep informed of the general outlines of relations between the Commission and industry. It should also consult with the Commission at regular committee meetings, on broad questions of policy affecting such relationships with industry. In addition to these defined functions, other opportunities for using the committee and its members would certainly develop once it began functioning.

By virtue of their membership on the Committee, the men would be available more readily to provide a channel of communication between the Commission and industry. In the same way, committee members would be available to assist the Commission in the difficult problem of recruitment of key personnel having industrial experience. They would also frequently be able to assist the Commission in developing its preliminary approach to specific problems affecting industry.

The use of temporary and special advisory committees for specific problems, in our opinion, has great merit. A year ago, when the Commission issued its regulations governing the export of certain types of equipment covered by the Atomic Energy Act, it announced that a special industrial advisory committee would be established to assist the Commission in its administration of the order. This is the type of committee which the war agencies, notably the War Production Board, used with effectiveness in administering similar orders during the war. We strongly recommend the use of such committees.

In creating these special committees, the Commission should look to the General Industrial Advisory Committee for assistance in establishing panels of possible members, defining terms of reference, etc. These committees will be useful to the Commission in the solution of its problems, but even more important, they will afford another means for bringing industry into direct personal contact with the subject matter of atomic energy.

AEC Reply to Industrial Advisors

December 28, 1948

DEAR MR. PARKER:

The Commission is indeed grateful to you and your colleagues of the Industrial Advisory Group for your report on measures to increase participation of American industry in the national atomic energy program. This report and the consultations your Group has held with the Commission and staff over the past twelve months exemplify the extraordinary cooperation that has been extended to the Commission by groups of leaders and experts in a variety of fields—medicine, mining, patents, etc.

We would like to make a few general observations on these recommendations with the thought that preliminary comment at this time might be useful to you and to us in our further thinking on these matters.

One point we would emphasize is that in recent months more firms have entered atomic energy work on a straight investment and risk basis. This is true not only in the field stressed in your report—the manufacture of compounds containing radioisotopes for use in research and process work, and the general use by industry of radioisotopes—but also in two other fields. One is the mining, milling, and processing of uranium ores into high-grade concentrates. The second is the manufacture of instruments for detecting radiation.

In all of these fields requirements of secrecy are at a minimum. In all of them there is the possibility of fairly immediate profit on money and manpower and plant invested. In the field of raw materials the Commission has offered firm price schedules for domestic uranium ore, and bonuses for the finding of new deposits of significant size. The Commission likewise has encouraged the postwar development of competitive industry producing radiation detection instruments. In wartime these were supplied largely by a single concern or by direct government production. Today some forty concerns, rather small in size for the most part, but growing, are making these instruments.

As for wider industrial participation in the atomic energy development financed and directed by the Commission, important developments have come within the past few days. Just this week, we are able to announce that two of America's industrial leaders are coming into key parts of the program:

1. E. I. duPont de Nemours and Company, which performed the great feat of the wartime construction and operation of the Hanford works, is undertaking a complete survey of chemical process problems involved in plutonium manufacture. Already several major industrial concerns are working on these matters — Blaw-Knox, Dow Chemical, General Electric, Kellex, Monsanto, and Standard Oil Development.

2. The Westinghouse Electric Corporation is undertaking the construction of test models of reactors for driving ships.

The Commission shares your desire for wider distribution of unclassified and declassified knowledge on atomic energy. To this end we are pushing ahead with plans for improving the methods of classifying and declassifying information so that everything which may be publicly issued without harm to the national security actually is issued. You will of course recognize that the industrial technology required for building and operating large-scale plants for production of fissionable materials is information most important to potential competitors, and therefore great care must be taken in determining whether it is to be generally issued.

With respect to your general proposals that the Commission operate special compiling and publishing services for industrial technicians and executives, we would like to emphasize the policy we have followed of helping and encouraging the technical and trade periodicals and publishing concerns to meet industry's needs in this field. We have avoided supplanting or duplicating the work of the journals and publishing houses in conveying technical and general information. We would be loath to abandon that policy. More cooperation from and with the Commission can doubtless improve the service, and we pledge such cooperation from our end.

As special reports of the sort typified by the isotopes sections of the Fourth Semi-annual Report to Congress become possible we shall make them, and we shall call attention of industry to the phases of the work which present a challenge or hold some promise for industry. The section on the reactor development program in the forthcoming Fifth Semi-annual Report will be of this general type and we hope that industrialists will be on the lookout for its issuance in late January. However, such reporting we believe should be auxiliary to rather than a replacement of the service of the technical and trade press and the professional societies to American industry.

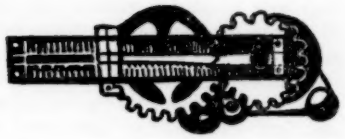
Your second proposal designed to make more information available to industry technicians and executives not working in the program through clearing a large group of them for access to restricted data requires further and close study. The advantages are manifest, and you have stated them with force and clarity. The practical difficulties for operations, and the difficulties respecting security, are very considerable. Our impression is that they need not be insuperable.

Several factors are pertinent to your proposal for a General Industrial Advisory Committee. In the past two years excellent results have come from the work of advisory committees set up to consult on the performance of functions within the atomic energy program, rather than set up on the basis of functions of groups outside the program. We now have a hard-working, effective group of such committees—on raw materials, biology and medicine, personnel management, isotope distribution, patents, and reactor safeguards. Obviously a problem here to be solved is that of integrating this operating system of functional committees with a general advisory function in addition to the one already created by the Atomic Energy Act of 1946. Perhaps the solution lies in more industrial representation on the functional committees; or perhaps a general industrial advisory committee is indeed needed. . . .

Please give to each member of the Group, the thanks of the Commission for your thoughtful examination and your comments and suggestions. Your report is received by the Commission with appreciation. Your recommendation that the Industrial Advisory Group be discharged from further duty as a group is accepted though we very much hope that the individual members will continue to make themselves available as consultants to the Commission.

(Signed) David E. Lilienthal,
Chairman

BRITISH ATOMIC SCIENTISTS ANNUAL CONFERENCE



The Annual Conference of the British Atomic Scientists' Association was held in London on October 30, 1948. The afternoon session, with Professor R. E. Peierls as chairman, was devoted to "Atomic Energy and Society"; the evening session, to "Atomic Energy and the Scientist." The following are excerpts from a report of the first session, published in the **Atomic Scientists News**, (11, January 7, 1949). Excerpts from the report on the second session will be published in our next issue.

PROFESSOR M. H. L. PRYCE spoke on "Constructive Applications of Atomic Energy."[1] He discussed in particular the question of raw materials, from two points of view: (*a*) possible utilization of uranium deposits of lesser uranium content than those used now, and (*b*) possible utilization of U-238 and of thorium, through "breeding." The technological possibilities of breeding, he said, are as yet uncertain, and, in any case, breeding, like capital growth by investment at compound interest, requires time and an at least partial renunciation of maximum atomic power production *now*. If the resources of atomic power are not to be squandered, the "atomic age" must be postponed by at least fifty years. He pointed out that, when this age comes, it will have some unpleasant features in the form of an accumulation of radioactive waste products. This could be an additional reason why atomic power may find its main use in regions remote from the centers of civilization.

STRATEGIC ASPECTS OF ATOMIC WEAPONS

Professor Blackett, speaking on the "Strategic Aspects of Atomic Weapons," opened by stating that it would be very generally agreed that the existence of a stock-pile of atom bombs in America is playing an important part in power politics in the world today. "Quite recently, Mr. Churchill said in the House of Commons: 'The atomic bomb alone stands between Europe today and complete subjugation to Communist tyranny.' This must be considered in the light of his other statement in the more bracing air of Llandudno, when he said: 'We ought to bring matters to a head and make a final settlement . . . The Western nations will be far more likely to reach a lasting settlement without bloodshed if they formulate their just demands while they have atomic bombs and before the Russians have got them too.' It could only mean that in the years (how many we do not know) that the Americans have a monopoly of atomic bombs, these should be used to force a settlement with Russia by the threat of their use. The *Times* comments that that would make Russia negotiate under duress, which we will not do in Berlin. If the Russians do not agree, we could drop the bomb and initiate a third world war. Many other statements to similar effect have been made in responsible journals in recent times. The *Observer*, in June, in reference to Berlin, said: 'It is we who hold the overwhelming trump card. It is our side, not the Russian, which holds the atomic bomb and atomic weapons and could, if sufficiently provoked, literally wipe Russia's power and threat to world peace from the face of the earth.' As to the objective of this policy of forcing a matter to its head, there are plenty of ideas canvassed. One concerns the issue of atomic energy control itself, holding that if Russia refuses a just settlement of control, that would be an act of aggression which would justify a preventative war. Another suggested objective has been the attainment within a short time of world government. The reason for this last demand seems to be the impression that a third world war would destroy civilization. The only way to prevent it is by world government. World government can only come by a third world war, so let us start one."

[1]See his article, "Atomic Power: What are the Prospects?" in the *Bulletin*, IV (August, 1948), 245.

[2]"The Atom Bomb as Policy Maker" *Bulletin*, IV (December, 1948), 381.

Bombing Alone Not Decisive

Professor Blackett then discussed the theory that a war with Russia could be decided in a comparatively short time, weeks or even days, by the use of atom bombs, and compared it with the very similar statements which were prevalent in the 1930's concerning the effects of bombardments with ordinary bombs. He said that these predictions conflicted very materially with the results of the bombing offensives on Germany and Japan in the recent war. He also compared the damage done in Russia by the German invasion with that which would be done by atom bombs and concluded that a very large number of the latter would be required to produce a comparable devastation. He quoted a recent statement by Mr. Brodie in America which implied that the American stock during the next few years would be numbered in hundreds rather than thousands.[2]

Professor Blackett continued: "Bombs are no use unless they can be delivered to their targets. The targets might be a long way away, perhaps hundreds of miles from any allied bases which we are likely to be able to use.

"I want to discard entirely the possibility that in a few years' time, rockets of the V2 type are to be of any use for this purpose. The V2 carried a one-ton warhead about 200 miles, which is a very material achievement. The opinion has been expressed by military and technical men that it will be a long time before rockets with atomic warheads will be able to go more than a few hundred miles. The size of the rocket then becomes enormous, and it is difficult to transport and difficult to handle. I think we can also discard V2's for another reason. They must be accurately aimed, and are not likely to be effective over long distances. The accuracy over London

was only about ten miles or so, and that sort of accuracy at many hundreds of miles is of little use, even on key cities.

"If we discard V1's and V2's, we are left with piloted bombers. At present bombers are becoming increasingly at a disadvantage compared with fighters. The reason is the development of jet-propulsion engines. It is well known by all people in touch with aero engineering that the small fighter is more quickly developed than the large bomber, which takes several years to get into production. The only bombers available to America, according to reports, are types like the B29. These are fine aircraft but they are slow indeed compared with contemporary jet fighters. There are no jet bombers in existence, and there is little reason to suppose that there will be any operational jet bombers available for some years' time. In the meantime, jet engines have put up the performance of fighters remarkably. There has never been a time in history when fighters have had a bigger advantage of speed over bombers than today. I think the maximum speed for bombers is about 300 or so m.p.h., while most countries have jet fighters with speeds between 500 and 600 m.p.h. This would make excursions carried out by unescorted bombers hazardous. Jet fighters have limited duration, about an hour in the air, which will limit the range of escorted bombers to not many hundred miles, certainly less than a thousand, so that long-range bombing in places far away must be carried out by unescorted bombers. Single and unescorted bombers have a high chance of being shot down. It may be necessary to send fifty bombers today with a few atom bombs in order to land them on a city. To deal a devastating blow that would wipe a country off the face of the earth would need a colossal air effort with many thousands of first-line, long-range bombers. Probably, in fact, the bombers would operate at night, when the fighter is at a disadvantage unless it is equipped with air-borne radar. Possibly the night bomber has some immunity because the job of fitting air-borne radar, so successful in the last war, may not yet have been achieved on a jet fighter. However, night bombing would probably require radar navigation and other devices. I think it is realistic to say that the task of carrying on a bomber offensive against cities thousands of miles away is going to be a big one.

"This consideration of air defense makes the matter of frontiers of extraordinary importance. Much loose thinking and talking has gone on to the effect that atom bombs make frontiers unimportant. They make them all-important. Every hundred miles which a country can push forward its air defense network gives an added chance of shooting down bombers."

Professor Blackett then quoted the editorial in the September *Bulletin* as indication that the belief that the Soviet Union can be defeated in a brief war, by atomic bombing alone, is giving way, in America, to a more realistic appraisal of the strategic situation.

He concluded by saying: "I want to put forward two propositions which seem to me exceptionally sound. First, we, as individuals and as members of organizations, political parties, and groups, have to do all we can to prevent the use of the present stockpile of American bombs to justify a move to embark upon preventative war. No one can predict for certain what a preventative war would bring, but the risks are so great, and the uncertainty so large, that it must be a counsel of complete despair to engage on a preventative war in the present situation, or even to make a preliminary statement, bringing matters to a head. For if an issue comes into the category of a national démarche and fails to come to a compromise, that leaves one with the necessity of ignominious retreat or of going into a preventative war.

"That is on the negative side. On the positive side, all one can do is to prepare the ground for a compromise between East and West as well as we can. Sooner or later we must resume much greater moves for world government. It is impossible to jump into world government in the present state of tension. I think that in a year or two's time, if war does not break out before then, it would be possible to approach a compromise on the control of the atom bombs and to limit their use and that of all other weapons adaptable to mass destruction.

[3]For a critical discussion of Professor Blackett's views, as set forth in greater detail in his book, see pp. 33-43 of this issue.

"I wish to remind you of the terms of reference of the UN Atomic Energy Commission. So far their deliberations have been limited to atomic bombs and no discussion has been carried on of the control of bacteriological weapons or of ordinary bombs. A discussion of these subjects may be little likely to be successful at the moment, but I think personally that it would in time become a much more reasonable proposition, just insofar as it is realized that the 'get-tough' policy based on atom bombs seems likely not to liquidate the Communists but to destroy those elements in Western policy that it sets out to save."[3]

INTERNATIONAL CONTROL

Sir George Thomson began his talk on "International Control" with a resumé of the work of the Atomic Energy Commission of the United Nations. He quoted the terms of reference under which the Commission was set up by the United Nations Assembly in January, 1946, and went on: "It met next June. I think that was a tragic delay, because in that six months a considerable change had taken place in the political temperature, especially as regards Russia.

"Two proposals were put forward in June, 1946: one by America, one by Russia. The Russian proposal consisted of two parts: the first, a convention outlawing the production and use of the bomb and providing for the destruction of stocks within three months; the second providing for the setting up of two committees, one for the exchange of scientific information and the other for considering methods of control and sanctions. No mention was made of inspection.

"The chief U.S. delegate, Mr. Baruch, put forward a plan known by his name, although in most respects it followed the earlier proposals of a committee headed by Lilienthal. The central idea is to set up an authoritative agency to control broadly all matters relating to atomic energy, with some small exceptions. Great stress was laid on the development activities of this agency. Research was to be a very important part of its work, and it was pointed out and stressed that the opportunities which this would give of recruiting to the agency first-rate scientific ability was a matter of the greatest importance because, without that, the control of any state which was trying to cheat was impossible. The plan also considered sanctions, as did that of the

Russians, but Mr. Baruch stressed that these sanctions should not be subject to the rule of unanimity of the Security Council, the so-called 'veto.'

"The majority on the Atomic Energy Commission approved the U.S. plan and considered that the plan of the Russians was unacceptable. They were then let in for a long and arid discussion, which led to a complete deadlock. It was, I think, General McNaughton who suggested that the matter be referred to a scientific and technical committee to see if any scheme of control was possible from a purely technical point of view. Dr. Kramers, the well-known Dutch physicist, a man of extraordinary tact, was chairman of this committee. He succeeded in getting an unanimous report. This was, in many respects, not much more than a re-hash of known facts, but it did contain the vital statement that control is 'technologically feasible.'

First Commission Report

"There then followed, in the autumn of that year, elaborate discussion and detailed study of control, particularly as regards what degrees of inspection or management were needed to ensure that dangerous materials should not be diverted from installations normally engaged in peaceful uses. Furthermore, they considered the possibility of clandestine production of bombs in some factory or institution which was not normally engaged on atomic energy at all. As a result, in December, 1946, the Commission published its first report. This followed the line of the Baruch Report, but not all parts of this report had been seriously considered. There was some discussion as to whether such a report should be published. Two countries, Holland and Mexico, were leaving the Security Council. It seemed proper that their representatives should be able to put their views on record, especially as they had taken a prominent part in the discussion. This report was passed by ten votes in favour, Russia and Poland abstaining.

"The first part of 1947 was devoted to amplifying this report and to the discussion of some amendments to it put up by Russia when it reached the Security Council. I am afraid that a large part of that was a waste of time. At the same time the elaboration of the Baruch scheme went on.

"In June, 1947, the Russian delegates put forward certain fresh proposals. These new proposals provided for periodic international inspection by a Control Commission. They were not very clear and the U.K. delegate sent in a questionnaire to elucidate them. The reply made clear, among other things, that the inspectors would not be resident, and no interference by the Commission in the running of the establishment would be permitted. Inspectors would visit only declared plants and those that were described as requiring special investigation in connection with possible clandestine activities. There was no machinery by which such activities could be detected. Also, the Soviet Union still refused to agree that the convention for outlawing the bomb should be simultaneous with that of setting up control. (As you know, this point has been quite recently conceded.) There was a lot of discussion on that. It was a favorite topic to bring up. In fact, I don't think most of us took it very seriously. Nobody seriously expected that the Russians thought that the Americans would agree to outlawing the bombs or destroying them before a convention was set up. On the other hand, the Russians were frightened of setting up a convention in which the exact stages by which the control would be established and the bombs destroyed were left vague.

"Most people felt, I think, that these two considerations more or less cancelled one another, and that any agreement which was eventually arrived at would involve simultaneity. There is no doubt that, if the Russian proposals of 1947 (greatly as they differed from the Baruch Plan) had been made in 1946, they would have been regarded as a great step forward. During the interval opinion had hardened and, in particular, it had been made clear from the technical discussions that management (and the U.S. demanded ownership) in many plants was essential to give a reasonable degree of security. Everybody except the Slav powers seemed deeply aware of the dangers of clandestine operation.

"In September, 1947, the second report was passed which amplified the Baruch Report in most matters, except for two important ones (1) the specification of the stages by which the report would come into force, and, in particular, at what stage the control would be considered sufficient to justify the destruction of existing bombs and the transfer of material in them to some international body; (2) the question of the quota of material and facilities which should be provided for in the treaty. The treaty was to lay down how much material should be allocated to each of the great powers and what facilities they were to have. The principle of the quota was agreed. At least no one dissented. The actual quota had not been considered. This second report was passed by ten votes for, and those of Russia and Poland against.

"After considering the Soviet proposals in more detail in the early part of this year, a third report, of April, 1948, admitted that the Commission could not agree. The matter has come up in a meeting of the Assembly of United Nations in Paris, where the Soviet Union revived the matter by suggesting that the concluding of the two conventions should be simultaneous. This, undoubtedly, is a very real concession, and, as I have said, one which was obviously essential if any agreement is to be arrived at. After some discussion a Canadian motion has been adopted by the first committee of the Assembly, 41 votes in favour, 6 against, and 10 abstentions. This requires the five great powers and Canada to try to find a basis for agreement. At the same time it asks the Atomic Energy Commission to resume its survey, and begins by asserting its approval of the first report referred to and the specific proposals of the second report, the plan which Russia has found itself unable to agree with.

Complete Security Unattainable

"So much for this frankly gloomy historical background. What can we make of it? Is the difference between the Slav powers and the rest of the world the result of details which can be overcome or of something more fundamental?

"First, I think one should consider the very strong position the United States is in. From the practical point of view, the U.S.A. is in the position of being able to say whether there shall be control or not. They are in the strong position of possessing the bombs, and of possessing a lead in their manufacture which it is hard to assess quantitatively but which, coupled with their great predominance in scientific and technical manpower, means that no country or combination of countries is likely to catch up with them for, I would say, something like another twenty years. The power of these bombs is likely to increase rather than diminish absolutely and,

as Professor Blackett has pointed out, the chances of dropping them successfully are likely to increase when the jet-propelled bombers become a reality —so that the U.S.A is in the position of holding something very substantial, and if they are to give it up, they want a reasonable bid.

Minimum Security Requirements

"From our point of view what are the essentials? I think clearly the greatest reasonable measure of security. By security I do not mean certainty that no country other than America can ever get bombs. That type of security is quite unobtainable. Whatever agreement is reached, nobody can be sure that some nation will not break it deliberately if it thinks the other countries are too weak or frightened to match its power. All one can get is the knowledge that the world will have warning before a nation uses atomic bombs. There is no doubt in my mind, and the unanimous report of the Scientific and Technical Committee contained the same conclusion, that this degree of security could be obtained, technically speaking. It involves a very substantial interference with sovereignty.

"There is no doubt in my mind, and I think in that of most others who have studied this question, that to get a reasonable degree of security it is essential that inspectors should be able to move about in all countries with the same degree of freedom that the ordinary citizen is able to move about in England at the present time. If it comes about that really large-scale power plants are set up, it will mean that special inspectors must have continued access to these plants to make sure that the atomic material is not diverted to the manufacture of bombs. Further, the inspectors must have some sort of guarantee against obstruction by the authorities of the country in which they are working. I think the question of sanctions has been made too dramatic, but I do think some kind of minor sanctions—if you call them that, but I prefer not to use that term—should be provided, and must be at the disposal of anybody who is to do this work. The sort of thing I envisage is the power to hold up supplies of uranium to factories for a certain time if that factory refused to allow proper inspection, something which would make it not worth while doing all the kinds of petty interfering which can make any organization lose heart.

"This, in my view, is the minimum. It may even be inadequate. I am certain that the U.S. would consider it so. Even this is more than Russia seems prepared to concede. I do not understand the Russian actions. All along, it has been a case of too little and too late. A concession which would have been hailed with joy, if made early, has merely intensified suspicion, because it is made so late and so grudgingly. I do not know why Russia is acting in this way—whether it is from stupidity or cunning. It is possible that Russia wants agreement but is so orientally minded that she thinks it is wisdom to ask ten times the amount she can expect to receive. If so, she is stupid. Or she may be making these concessions to save her face in the knowledge that they cannot be accepted. I do not know, and I doubt if anybody does beside herself. But it is clear that this real concession which she has just made must be followed up energetically and with the intention of seeing if it really means that she wants an agreement or whether it is just a piece of adroit, or perhaps not very adroit, propaganda.

Goal is to Remove Mutual Suspicion

"One point I would like to stress. It is just as important that a scheme of control should *seem* secure as that it should be so. The main object of the world at the present time must be to avoid a war. In that respect, at least, I am entirely at one with the idea of the preceding speaker. I think starting a war is just plain wicked. A major war, whether atomic weapons are used or not, is likely to be the death of Western Europe. I think the success of any agreement must be judged by the extent to which it succeeds in removing suspicion between the nations that one of them is trying to produce hidden armaments. This can only be done if it is clear to everybody that the system of control is adequate. A system which is not obviously adequate is worse than useless, even if, in fact, no evil person makes bad use of it. The point is that you should be clear that nothing of this kind is being worked out against you.

"Unfortunately, it is just such a suspicion that now exists between East and West that makes agreement apparently impossible. I do not feel the problem is so difficult intrinsically but it needs good will. I do not mean by that the sort of implicit faith you have in life-long friends, but the kind of attitude a normal businessman has to another businessman whom he has no special reason to suppose is trying to cheat him—the sort of mutual prepared-to-be-reasonable attitude one adopts in everyday life.

International Law Necessary

"At present Russia undoubtedly feels that the world is united against her, and the world regards Russia as a danger to peace. It seems to me that if a scheme of control is to work, certainly if a scheme of control is to work under the auspices of the United Nations, the nations must be prepared to accept a majority decision, even if it sometimes seems unfair. (A majority decision must carry with it the prima facie assumption that the decision is just.) Certainly we need some kind of international law so that a nation cannot have its vital interests attacked by the votes of other nations who might be activated by jealousy or other unworthy motives. This is why the veto was instituted in the first place. It is only defensible, however, if used when the interest is actually a vital one.

"I am afraid one has to leave the matter in this rather unsatisfactory position; I do not think there can be much hope in Professor Blackett's suggestion of combining control of atomic bombs with other methods of mass destruction. The control of atomic energy is technologically feasible at present because it depends on a rather rare substance, uranium, and because in practice it involves large factories to make the bomb material. The control of bacteriological warfare has never been seriously considered and may well be impossible. It does not involve any special material, and the work can probably be done in a small plant. I feel the attempt to link these other weapons of mass destruction with the problems of atomic energy is a hopeless one. What seemed hopeful at the beginning, particularly in America where the original plan was framed, was that the extremely dramatic character of the atom bomb would make the people of the world realize that something has got to be done. It happened that here was a case in which international control was technically possible. If advantage had been taken of that fact to set up control, it is possible that relations might have improved and control of other weapons would have become possible. It seems to have failed. I am sure that combining it with

other things, more difficult to control, will not make it succeed."

Professor Mott, speaking on "National Policy," said that, although scientists as individuals do not agree on political issues, scientists acting as a body can be useful in "operational research," that is, the unemotional analysis of the probable effects of any military or political course of action. This is what Professor Blackett has done in the part of his book showing that strategic bombing, even with atomic bombs, is an indecisive weapon. Its threat represents less of a deterrent to Russian aggression than the threat of a long-drawn-out land war.

"Unfortunately the question whether or not strategic bombardment is going to be an effective way to keep the peace is going to be be-deviled with politics. The statement that you cannot keep the peace in that way is going to be associated with the extreme left. It ought not to be. I believe this to be certain—the importance of strategic bombing as a weapon of policy, and the importance of the threat of strategic bombing as a weapon of policy, goes deeper than a show between right and left in politics.

"I would like to address myself to those of my audience who, I am sure, are, in political issues, like the great mass of people in this country, who stand at the center and consider that the things in which one should believe passionately are not these political issues of the right and left. I want to address myself to people who think as I do, that both parts of the world can live without terror of one another, and that the quality of tolerance which we value can be made to grow on both sides. To this end, I think the best thing to do is to build up our defensive arrangements, to hold what can be held, be it in Great Britain or Africa (I would not attempt to estimate a strategy in that respect), to build up defensive armaments so that, if war breaks out, a defensive screen will exist, behind which the forces of democracy will be mobilized.

"I do not believe that any part of the peace policy of the West should be to build up long-range strategic bombers, and use them as a threat. It seems a policy of pauperism which, if we adopt it, will make the name of Britain and America hateful to all the common peoples of Europe and Asia."

DISCUSSION

The chairman called first on Dr. E. U. Condon, Director of the National Bureau of Standards in Washington. In relation to Professor Pryce's talk, he stated that the rather pessimistic conclusions with regard to the time scale involved in the production of electric power on an industrial scale from atomic energy were in agreement with similar analyses made in the U.S.A.

With regard to the use of the atom bomb in war, he said, "One should not overlook the possibility of the delivery of the bomb by sabotage or fifth columnists. While the bomb cannot be carried in a suitcase, it can be carried in a merchant vessel, and those countries which have many ports have a serious concern about their defense against unannounced attack. I think surprise attack is a factor that cannot be overlooked. Also, it is common knowledge that important technical advances are being made. One instance is the way in which jet fighters are being carried by bombers so that the fighters do not need to have the bombers' range." He went on to discuss the question of international control and emphasized that any scheme of inspection which was to be of any value must involve complete freedom for the inspectors to go where they willed. This involved sacrifices by both sides. Russia was naturally reluctant to disclose the location of her essential industries and America was equally reluctant to disclose the details of the processes that went on in her factories. The effects of a comprehensive scheme of inspection must be very wide-ranging and impinge upon every phase of a nation's economy.

Dr. Condon ended by saying: "I would like to close with a protest. I think there is no point in denying that there is a conflict between East and West. There is a conflict between ideologies and social systems as to which can offer more for human freedom or the spiritual growth of human society. In that matter we are convinced that our system offers most. I do think we are making a great mistake if at this stage we take war for granted. I feel the Russians have always thought they could bring the world to their side by propaganda methods, and if we ourselves concentrate on discussing the technique of war rather than showing that our system is a superior system we will lose to them in propaganda."

Mr. Townley Searle and Mr. Blackland Stubbs asked Professor Blackett if the radioactivity left by the bomb should not be considered as a serious factor in assessing the damage it would produce. Mr. Blackland Stubbs also asked if the bomb would not do more damage if it were fused to explode on contact.

Professor Blackett replied: "The first point was about parasitic fighters. I think that they will be of value to offensive operations. However, there is one and only one existing aircraft which will be available for two or three years. I think that the existing B-29's cannot be converted in time to have any effect in a major war in the immediate future. As a long-term proposition they may be effective. When we come to fitting fighters to jet bombs, however, the problems are quite difficult. The drag on the aircraft leads to an appreciable drop in range. I do not think they will be decisively effective by day against heavily defended country because in many cases the enemy can put up more fighters than are carried by the bombers. They are one of the factors which would make deep penetration possible, but I doubt whether it would be for many years.

"The second point dealt with radioactivity. The bombs at Nagasaki and Hiroshima were exploded at 2,000 feet, which was chosen to give the maximum destructive effect. If exploded lower down they would have less destructive effect, but leave much greater radioactivity. I think that may add horror to the bombing, but whether it would be better to explode them low down or high up I do not know. If you wanted to immobilize a railway center, a bomb exploded low down might put it out of action for a long time. There is also another weapon we have not mentioned so far, the use of radioactive poison, which can, in principle, be used as a weapon to cover an area of a country. In American writing there is a lot of evidence that this is a possible and highly destructive weapon. Like gas and bacteriological weapons, it can only be used on extended territory, and is useless in a confused situation of national and civil war such as would take place in Europe in the case of a third world war. It is true that a bomb dropped in a harbor would prevent it being used for a long

time. That gives a tactical weapon which is very valuable. If the Russians had some bombs, harbors through which American supplies were finding their way into Europe could be immobilized. A third world war must depend on shipping supplies. I think that is one of the reasons why the Editorial in the *Bulletin of the Atomic Scientists* which I quoted lays great stress on the worsening of the position when the Russians have atomic bombs. Such a use is of more value to the Russian defensive than bombs dropped on land."

Mr. J W. Jeffery put two questions. First, what would be the effect upon an attacking bomber force if one was destroyed by the defense? Would it not destroy the whole force? Second, would Professor Blackett reply to the criticism that he had overlooked the effect of the saturation of the defenses by a large-scale attack in which as much damage would be done in one or two nights as was done in the whole of the last war.

Professor Blackett, in his reply, stated that the destruction of a bomber would not necessarily entail the detonation of the bomb it carried. He added a point on Dr. Condon's remark concerning the delivery of the bomb by merchant vessels. "There is a chance of this. I think it is exaggerated for the following reason. A country which plans aggressive war is extremely unlikely to rely on that sort of thing. It could only be useful if followed up by invasion, preparations for which would be sufficiently obvious to preclude surprise. To prevent such an attack in this case, the simplest thing would be to keep all foreign ships out. Russia has not many merchant ships."

Mr. J. B. Hasted said: "I would like to combine two questions in a brief statement, on the subject of international control, ownership and inspection. I feel myself that the Russian proposals deserve perhaps a fuller consideration than has been given them, not as a perfect blueprint but simply from the point of view of somewhere to start on these two issues. The association pointed out in 1947 that some form of control is quite possible without the obvious embarrassment, whether to the Soviet Union or to ourselves even, of a large part of the national economy coming under the control of someone else. Of course, it is true, as our speakers have told us, that inspection only of declared installations is not a guarantee of safety, but for a number of technical reasons it is nevertheless nearly as good. This would be even more true if there was a Russian compromise on the residence of inspectors in the declared installations. When it becomes imperative for America to have international control because of her diminishing start in the manufacture of fissile material, it will probably be (and this is only a personal opinion) on this basis of agreement that the control is reached. Is it, then, simply a matter of waiting for the day when America and ourselves realize that concessions must be made? I do not think so. It is a matter of taking up every compromise. We have heard of this compromise on the matter of two simultaneous conventions. It is up to us to take up every compromise and use it to the best advantage, making it the opportunity of further discussion and pursuing the matter perhaps as much from the point of view of the scientist as that of the businessman of which we have heard."

AEC Criteria for Security Clearance

The **Bulletin** *here publishes in full the AEC's official policy statement on security clearance for personnel. This is the first official statement since the announcement of the Interim Procedure in April, 1948. See* **Bulletin,** *IV (July, 1948), 198.*

The United States Atomic Energy Commission has adopted basic criteria for the guidance of the responsible officers of the Commission in determining eligibility for personnel security clearance. These criteria are subject to continuing review, and may be revised from time to time in order to ensure the most effective application of policies designed to maintain the security of the project in a manner consistent with traditional American concepts of justice and rights of citizenship.

The Commission is revising its hearing procedure entitled "Interim Procedure" for the review of cases of denial of security clearance and for the conduct of hearings for employees desiring such review. The Interim Procedure announced April 15, 1948, places considerable responsibility on the Managers of Operations and it is to provide uniform standards for their use that the Commission has adopted the criteria described herein.

Under the Atomic Energy Act of 1946, it is the responsibility of the Atomic Energy Commission to determine whether the common defense and security will be endangered by granting security clearance to individuals either employed by the Commission or permitted access to restricted data. As an administrative precaution, the Commission also requires that at certain locations there be a local investigation, or check, on individuals employed by contractors on work not involving access to restricted data (Commission authorization to be so employed is termed "security approval").

Under the Act the Federal Bureau of Investigation has the responsibility for making an investigation and report to the Commission on the character, associations, and loyalty of such individuals. In determining any individual's eligibility for security clearance other information available to the Commission should also be considered, such as whether the individual will have direct access to restricted data, or work in proximity to exclusion areas, his past association with the atomic energy program, and the nature of the job he is expected to perform. The facts of each case must be carefully weighed and determination made in the light of all the information presented whether favorable or unfavorable. The judgment of responsible persons as to the integrity of the individuals should be considered. The decision as to security clearance is an over-all, commonsense judgment, made after consideration of all the relevant information, as to whether or not there is risk that the granting of security clearance would endanger the national defense or security. If it is determined that the common defense and national security will not be endangered, security clearance will be granted; otherwise, security clearance will be denied.

Cases must be carefully weighed in the light of all the information, and a determination must be reached which gives due recognition to the favorable as well as unfavorable information concerning the individual and which balances the cost to the program of not having his services against any possible risks involved. In making such practical determination, the mature viewpoint and responsible judgment of Commission staff members, and of the contractor concerned, are available for consideration by the Manager of Operations.

To assist in making these determinations, on the basis of all the information in a particular case, there are set forth below a number of specific types of derogatory information. The list is not exhaustive, but it contains the principal types of derogatory information which indicate a security risk. It will be observed that the criteria are divided into two groups, Category (A) and Category (B).

Category (A) includes those classes of derogatory information which establish a presumption of security risk. In cases falling under this category, the Manager of Operations has the alternative of denying clearance or referring the case to the Director of Security in Washington.

Category (B) includes those classes of derogatory information where the extent of activities, the attitudes or convictions of the individual must be weighed in determining whether a presumption of risk exists. In these cases the Manager of Operations may grant or deny clearances; or he may refer such cases to the Director of Security in Washington.

CATEGORY A

Category (A) includes those cases in which there are grounds sufficient to establish a reasonable belief that the individual or his spouse has:

1. Committed or attempted to commit, or aided or abetted another who committed or attempted to commit any act of sabotage, espionage, treason or sedition;
2. Established an association with espionage agents of a foreign nation; with individuals reliably reported as suspected of espionage; with representatives of foreign nations whose interests may be inimical to the interests of the United States. (Ordinarily this would not include chance or casual meetings; nor contacts limited to normal business or official relations.)
3. Held membership in or joined any organization which has been declared to be subversive by the Attorney General, provided the individual did not withdraw from such membership when the organization was so identified, or otherwise establish his rejection of its subversive aims; or, prior to the declaration by the Attorney General, participated in the activities of such an organization in a capacity where he should reasonably have had knowledge as to the subversive aims or purposes of the organization;
4. Publicly or privately advocated revolution by force or violence to alter the constitutional form of Government of the United States.

Category (A) also includes those cases in which there are grounds sufficient to establish a reasonable belief that the individual has:

5. Deliberately omitted significant information from or falsified a Personnel Security Questionnaire or Personal History Statement. In many cases, it may be fair to conclude that such omission or falsification was deliberate if the information omitted or misrepresented is unfavorable to the individual;
6. Violated or disregarded security regulations to a degree which would endanger the common defense or national security;
7. Been adjudged insane, been legally committed to an insane asylum, or treated for serious mental or neurological disorder, without evidence of cure;
8. Been convicted of felonies indicating habitual criminal tendencies;
9. Been or who is addicted to the use of alcohol or drugs habitually and to excess, without adequate evidence of rehabilitation.

CATEGORY B

Category (B) includes those cases in which there are grounds sufficient to establish a reasonable belief that with respect to the individual or his spouse there is:

1. Sympathetic interest in totalitarian, fascist, communist, or other subversive political ideologies;
2. A sympathetic association established with members of the Communist Party; or with leading members of any organization which has been declared to be subversive by the Attorney General. (Ordinarily this would not include chance or casual meetings, nor contacts limited to normal business or official relations.)
3. Identification with an organization established as a front for otherwise subversive groups or interests when the personal views of the individual are sympathetic to or coincide with subversive "lines";
4. Identification with an organization known to be infiltrated with members of subversive groups when there is also information as to other activities of the individual which establishes the probability that he may be a part of or sympathetic to the infiltrating element, or when he has personal views which are sympathetic to or coincide with subversive "lines";
5. Residence of the individual's spouse, parent(s), brother(s), sister(s), or offspring in a nation whose interests may be inimical to the interests of the United States, or in satellites or occupied areas thereof, when the personal views or activities of the individual subject of investigation are sympathetic to or coincide with subversive "lines" (to be evaluated in the light of the risk that pressure applied through such close relatives could force the individual to reveal sensitive information or perform an act of sabotage);
6. Close continuing association with individuals (friends, relatives or other associates) who have subversive interests and associations as defined in any of the foregoing types of derogatory information. A close continuing association may be deemed to exist if:
   (1) Subject lives at the same premises with such individual;
   (2) Subject visits such individual frequently;
   (3) Subject communicates frequently with such individual by any means.
7. Association where the individuals have enjoyed a very close, continuing association such as is described above for some period of time, and then have been separated by distance; provided the circumstances indicate that a renewal of contact is probable;

Category (B) also includes those cases in which there are grounds sufficient to establish a reasonable belief that with respect to the individual there is:

8. Conscientious objection to service in the Armed Forces during time of war, when such objections cannot be clearly shown to be due to religious convictions;
9. Manifest tendencies demonstrating unreliability or inability to keep important matters confidential; wilful or gross carelessness in revealing or disclosing to any unauthorized person restricted data or other classified matter pertaining either to projects of the Atomic Energy Commission or of any other governmental agency; abuse of trust, dishonesty; or homosexuality.

While security clearance would ordinarily be denied in each of the foregoing categories (A), and (B), security approval, as distinguished from security clearance, might be warranted in those types of derogatory information mentioned under Category (B) above.

The categories outlined hereinabove contain the criteria which will be applied in determining whether information disclosed in investigation reports shall be regarded as substantially derogatory. Determination that there is such information in the case of an individual establishes doubt as to his eligibility for security clearance.

The criteria outlined hereinabove are intended to serve as aids to the Manager of Operations in resolving his responsibility in the determination of an individual's eligibility for security clearance. While there must necessarily be an adherence to such criteria, the Manager of Operations is not limited thereto, nor precluded in exercising his judgment that information or facts in a case under his cognizance are derogatory although at variance with, or outside the scope of, the stated categories. The Manager of Operations upon whom the responsibility rests for the granting or denial of security clearance, and for recommendation in cases referred to the Director of Security, should bear in mind at all times that his action must be consistent with the common defense and national security.

Lang's Early Tales of the Atomic Age

Reviewed by Edward Teller

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Early Tales of the Atomic Age.
By DANIEL LANG, New York: Doubleday, 1948. Pp. ix+223. $2.75.

IN THE Introduction written to Daniel Lang's *Early Tales of the Atomic Age*, Carl van Doren calls this book "the Bulfinch of this sudden new atomic mythology." But whereas Bulfinch had no sources but the old stories themselves, Mr. Lang, telling his new stories, goes back of them to such facts as he is permitted to print. It is somehow as if Bulfinch had been able to give a true account of the operation of the Oracle at Delphi, or of the career of Prometheus, or perhaps of the political shenanigans behind the trial of Socrates.

With my appetite thus whetted, I started to devour the promised feast of inside information. This is what I found:

One chapter describing how well and how efficiently the secret was kept during the war by the military authorities.

Four chapters describing local color at Oak Ridge, Brookhaven, and Los Alamos. (Sample: "The thirty-five-mile ride from . . . Santa Fe to Los Alamos . . . is a wearying, not particularly attractive journey.")

A report on a visit to Hiroshima. Here it is Morrison who speaks. No one can listen to that tale without deep interest and awareness of a great tragedy.

A flattering description of the efforts of atomic scientists.

An expedition to explore a cave. The problem of hiding from the atom bomb is made to sound like quite an adventure.

Two interesting chapters on the rocket-site at White Sands, New Mexico. Due and realistic emphasis is placed on the rattlers and the scientists. (No hint is intended—they came in different chapters.)

The story of the Lilienthal Plan and a chapter on the Atomic Energy Commission.

Of the real early story of atomic energy, the reader will not find a single word in the book. There is no mention of the futile efforts of the scientists in 1939 to awaken the interest of military authorities in the atomic bomb. There is little description of the long and difficult period of scientific and industrial organization and effort during the war. The reader does not learn of the dismay of scientists faced with the necessity of planned research. He does not find out about the indignation of engineers asked to believe in the theory, and, on such airy basis, to construct a plant.

What the book does describe is the impact of the full-grown atomic project upon some phases of our national and private life. This task is accomplished with much wit and with some understanding. In the background one always feels the presence of the destructive weapon with which the word "atom" has been linked.

ALL the chapters have appeared as articles in the *New Yorker*. Since that magazine is the highest authority on humor, a word about the jokes contained in the book may be permitted. These jokes can be divided into five classes: those understood by author and reader, those intended by the author and missed by the reader, the unintentional jokes enjoyed by the reader, the jokes which go unnoticed by all (including the author), and, lastly, the jokes not mentioned in the previous four classes. I found a beautiful specimen belonging to the last class: Fermi, meaning the pseudonym Farmer, has difficulties when trying to enter Hanford because the alert guard detects his Italian accent. He is rescued by Wigner's pronunciation of the sentence: "His name is Farmer as truly as mine is Wagner."

Du Pont To Survey Chemical Processes in Plutonium Production

The U. S. Atomic Energy Commission has obtained the services of the du Pont Company, of Wilmington, Delaware, in surveying the total problem of research and engineering involved in improving the chemical processes used in production of plutonium.

Plutonium is one of the two fissionable materials to which a major portion of the production program of the national atomic energy program is devoted. Improvements in the chemical phases of the production process offer the best promise of increasing the amount of plutonium produced from a given quantity of uranium, and of simplifying the handling of the wastes of the production process.

The survey is expected to lead to important conclusions and recommendations concerning the plutonium chemistry development program.

Radioisotope Training Given To Foreign Scientists at Oak Ridge

The AEC recently approved the attendance of two foreign scientists at a radioisotope technique training school conducted by the Oak Ridge Institute of Nuclear Studies. The two scientists, one from England and one from India, are the first foreign students to participate in the Institute's program.

Applications have been received from a number of foreign scientists. Only those from countries which have qualified to receive radioisotope shipments are eligible to attend the courses, and they will be accepted for training insofar as their attendance does not deprive qualified U. S. scientists of opportunity for enrollment. Each session is limited to thirty-two participants.

Twenty-seven nations have now qualified to receive radioisotopes, and nineteen have received shipment since September 3, 1947. The five nations which have qualified most recently are Mexico, Guatemala, Brazil, Colombia, and Finland.